DOCUMENT RESUME

ED 277 556 SE 047 651

AUTHOR	Muthoka, Margaret; Rego, Assumpta B.
TITLE	Environmental Education: Module for In-Service Training of Social Science Teachers and Supervisors for Secondary Schools. Environmental Educational Series 10.
INSTITUTION	United Nations Educational, Scientific, and Cultural Organization, Paris (France). Div. of Science, Technical and Environmental Education.
REPORT NO	ED-84-WS-54
PUB DATE	85
NOTE	134p.; For other publications in this series, see SE 047 645-652.
AVAILABLE FROM	UNESCO, Documentation and Information Centre, Sector of Education, 7 place de Fontenoy, Paris 75700, France.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052) -- Reports - Descriptive (141)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Course Content; Ecology; Educational Games; *Environmental Education; Evaluation Methods; Global Approach; Higher Education; *Inservice Teacher Education; Interdisciplinary Approach; International Organizations; Learning Modules; Secondary Education; Social Sciences; *Social Studies; Teaching Methods
IDENTIFIERS	Environmental Education Programs

ABSTRACT

The International Envrionmental Education Programme (IEEP) of UNESCO has produced a series of teacher training modules in environmental education. This experimental module focuses on the inservice training of social science teachers and supervisors in environmental education. The document is divided into chapters which cover: (1) the history and philosophy of environmental education, along with some goals, objectives, and guiding principles; (2) basic ecological principles and some of the interactions between natural and cultural environments; (3) environmental problems and possible solutions and/or methods of prevention; (4) several teaching methodologies in environmental education, with a particular emphasis on problem solving; (5) suggested activities and experiments intended to facilitate the teaching of the environmental dimension of secondary social science subjects; (6) evaluation in environmental education; and (7) strategies for planning, developing, implementing and managing an environmental education program. A glossary of terms is included, as well as a bibliography. (TW)

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Unesco-UNEP International Environmental Education Programme

Environmental Educational Series **10**

Environmental Education: Module for In-Service Training of Social Science Teachers and Supervisors for Secondary Schools

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UNESCO

Division of Science, Technical
and Environmental Education

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ED-84/WS/54

PREFACE

A series of experimental modules for the pre-service and in-service training of primary-school teachers, secondary-school science and social science teachers in environmental education has been prepared in the context of the Unesco-UNEP International Environmental Education Programme (IEEP) as a follow-up to the Tbilisi Conference Recommendations with respect to the training of teachers in environmental education.

This module focuses on the in-service training of social science teachers and supervisors in environmental education for secondary schools. In this context the social science teachers are those concerned with the teaching of history, geography, social studies, economics, civics and ethics. The main objectives of the module are to (a) foster the acquisition and transfer of knowledge, skills and affective attributes concerning the environment and its problems and (b) develop competence in the teaching and supervision of the environmental dimension of social science in secondary schools. In this context, the module treats (a) historical and philosophical development of environmental education (b) essential knowledge about the environment and its problems (c) teaching methodologies, activities and experiments and evaluation in environmental education (d) strategies for planning, development, implementation, management and evaluation of the environmental dimension of secondary school social science.

The Module for In-Service Training of Social Science Teachers and Supervisors in Environmental Education for Secondary Schools has been prepared under Unesco contract at Kenya Science Teachers College, Nairobi, Kenya, by Mrs. Margaret Muthoka and Miss Assumpta B. Rego. In the process of the preparation, the first draft of the module was circulated for comments and critics to about twenty professionals and institutions around the world. Also, the draft of this module was studied for revision and its local adaptation by teacher educators at the Subregional Workshops on Teacher Training in Environmental Education for Asia organized at the National Council of Educational Research and Training, New Delhi, India, 3-16 March 1983, and at the Subregional Workshop on Teacher Training in Environmental Education for the Caribbean organized at the School of Education, University of the West Indies, Mona, Kingston, Jamaica, 18-29 July 1983. Unesco appreciates the efforts of those who have contributed in the preparation of this module, and of Professor Willard J. Jacobsen, Teachers College, Columbia University, New York, U.S.A., who edited the final version.

Comments for improving the future versions of this module are invited to be sent to the following address:

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CONTENTS

Page

PREFACE i

INTRODUCTION 1

OBJECTIVES OF THE IN-SERVICE TRAINING OF SECONDARY SCHOOL SOCIAL SCIENCE TEACHERS AND SUPERVISORS IN ENVIRONMENTAL EDUCATION 3

Chapter 1: Environmental Education (EE) 4

Chapter 2: Essential knowledge about the environment for secondary school, social science teachers and supervisors 11

Chapter 3: Essential knowledge for secondary school social science teachers and supervisors about the problems of the environment and means and ways for their solution and prevention 32

Chapter 4: Teaching methodologies in environmental education with special emphasis on problem solving approaches 53

Chapter 5: Suggested experiments and activities to facilitate the teaching and learning of the environmental dimension of secondary school social science subjects 76

Chapter 6: Evaluation in environmental education 101

Chapter 7: Strategies for planning, development, implementation, management and evaluation of the environmental dimension of secondary school social science curriculum 110

GLOSSARY 114

BIBLIOGRAPHY 121

INTRODUCTION

This module is written as an in-service training module for the purpose of assisting individuals and institutions interested in the in-servicing of social science teachers and supervisors in Environmental Education (EE) for secondary schools.

The module covers many aspects of EE thought necessary for secondary level instruction. The content includes the history and philosophy of EE; its goals, objectives and guiding principles; essential knowledge about the environment and its major problems and possible solutions; appropriate teaching methodologies with a sample selection of activities and experiments; the evaluation of the teaching and learning; the planning and implementation strategies for in-service programmes. A glossary is included to assist those who might not have had the opportunity to study the natural science courses or to reinforce the knowledge of those already familiar with such concepts. An extensive bibliography has been prepared and we record here our full acknowledgement to the copyright holders and publishers whose books have been referred to.

More detail is contained in the chapters dealing with essential knowledge and problems of the environmental and instructional strategies and activities in EE. It was thought that these are important and useful to teachers and supervisors in secondary schools.

No claim is made to an exhaustive treatment of any of the topics. The material is selective and concise. The authors have drawn heavily on their own knowledge and experience gained from having planned and established a pre-service course in EE in a secondary school science teachers' college, the first of its kind in Eastern Africa. For this reason the module tends to focus on strategies and solutions to environmental problems and issues that are potentially workable in developing countries. The challenge has been to prepare this module to cater for an international audience, a task we hope we have accomplished to a large extent. Any suggestion to improve on this point is welcome.

It should be understood that the authors can only write with conviction on situations and events within their realm of experience and knowledge. However, the application of ecological principles and concepts in environmental conservation and management hold true regardless of geographical location and economic status.

This module is primarily addressed to secondary school social science teachers and supervisors who have had little or no orientation toward environmental education. The social science teacher is identified as a teacher of History, Geography, Social Studies, Civics, Ethics,and Economics, and Art. It was recongized that social science teachers already use much material related to the environment and hence this could provide possibilities for the infusion of the environmental dimension when teaching this content. Topics which are considered suitable include population, human settlements, food, water, morality, illiteracy, unemployment, degradation and depletion of natural resources, ways in which people organize themselves, and their relationships to the natural and social environments, customs, traditions and histories. It was thought that the in-service training must aim at making the social science teacher competent in fusing EE as a new dimension in the social science subjects taught; not as a mass of content but as a new perception of relationships and the acquisition of new values within the Social Science context.

In this context EE in-service training for the secondary school social science teachers and supervisors should aim at developing responsible behaviour towards the environment, helping young people to acquire suitable attitudes and values which make for citizens who are self-disciplined, self-reliant and who understand their place in nature.

"Development without Destruction" on a personal, community, national and international level was considered an apt slogan for EE.

Internationally, EE aims at a cooperative spirit for the solution and prevention of environmental problems and for the improvement of the quality of the environment. In view of this, the in-service training as outlined in this module has concentrated on the methods for problem solving, values clarification, selection and the use of materials. It was noted that possible curriculum tasks for social science teachers may include:

1. Identifying the environmental problem.

2. Investigation into an environmental problem.

3. Preparing and elaborating on possible solutions.

4. Do I want to get involved?

(It is emphasized that attitude change and consequent action is a PERSONAL thing. Each individual has to be responsible in the final analysis for his own change. He or she can receive direction and guidance from outside, but he or she is the ULTIMATE one responsible for internalizing the new).

5. Identify possible strategy for social action.

6. Evaluation of social action.

7. A Social Action Challenge: an educational and environmental augmentation.

There is no doubt, that teacher behaviours do have an influence on student classroom behaviours. Therefore it is implicit in activities aiming for changed student behaviours that teachers be the models of the desired behaviours by ACTION or by WORD. It is hoped that this in-service training module will be a means to developing these desired behaviours in teachers that will encourage similar student behaviours through positively acquired attitudes.

This module was written in response to Unesco's invitation. The preparation has necessitated wide reading of materials prepared in the context of Unesco/UNEP International Environmental Education Programme (IEEP) and as a follow-up to the Tbilisi Conference recommendations with respect to teacher training and curriculum development. In revising an earlier draft we have been very much helped by the comments and suggestions of a number of reviewers and we wish to record our gratitude to all.

The differences in environments and school systems make it difficult to suggest specific implementation requirements. Each training center should devise its own requirements based on local environmental conditions and problems, available resources and the current national, regional and global issues.

The authors thank Unesco for making it possible to share some of their knowledge and experience on this very vital aspect of the educational process towards achieving a quality environment and a good quality of life.

OBJECTIVES OF THE IN-SERVICE TRAINING OF SECONDARY SCHOOL SOCIAL SCIENCE TEACHERS AND SUPERVISORS IN ENVIRONMENTAL EDUCATION:

A. GENERAL OBJECTIVE:

To develop competence in the teaching and supervision of the environmental dimension of social science in the secondary school.

B. SPECIFIC OBJECTIVES:

1. To increase environmental awareness, sensitivity and consciousness of social science teachers and supervisors toward the environment, its problems and their solution and prevention.
2. To acquaint social science teachers and supervisors with the need, the importance, the goals, objectives and guiding principles of environmental education.
3. To acquaint social science teachers and supervisors with essential knowledge about the environment and its allied problems.
4. To acquaint social science teachers and supervisors with fundamental environmental concepts that may permeate social science subjects.
5. To help social science teachers and supervisors realize the totality of the environment as a fundamental base for interdisciplinarity among school subjects.
6. To familiarize social science teachers and supervisors with teaching methodologies such as problem-solving approaches, in environmental education, especially with respect to the teaching of the environmental dimension of secondary school social science subjects.
7. To familiarize social science teachers and supervisors with certain activity and experiments essential to and motivating for the learning and teaching of the environmental dimension of secondary school social science subjects.
8. To familiarize social science teachers and supervisors with the development of lesson plans and the preparation of teaching materials in the form of units or modules, etc. on the environmental dimension of secondary school social science subjects.
9. To familiarize social science teachers and supervisors with evaluation techniques and methodologies in environmental education for understanding the progress of secondary school students, as well as the teacher's own teaching effectiveness with regard to the fundamental environmental dimension of secondary school social science subjects in fulfillment of environmental education objectives.

CONCLUSION

It is hoped that this module will provide sufficient guidelines for teachers and supervisors to successfully integrate EE concepts and teachings with the secondary school social science courses of study.

Furthermore it is suggested that those teachers who feel committed to educate for the environment continue to:

1. Expand and deepen their knowledge and understanding of environmental matters by further reading.
2. Seek out the professionals in environmental matters and request more information on environmental impact studies on local projects.
3. Devise ways of making the teaching of EE more interesting and meaningful by use of innovative methodologies.
4. ACT the code of behaviour that emphasizes equity and social justice for all peoples of the world and reject the exploitation of one to benefit the other.

Only then can "Development without Destruction" become a lasting reality for the generations to come.

Chapter 1

ENVIRONMENTAL EDUCATION (EE)

Introduction

This chapter provides the rationale for EE and outlines the events that led to the present status of EE and will serve as a bone for the fostering of attitudes and values promoted by EE and the development of problem solving skills.

History

EE is not a new discipline but a new dimension in the education system which has developed as a result of the acceptance of the complexity and urgency of environmental problems. Education has always associated itself with the environment informally through folklore and formally in national literature teaching about the environment and humanity's relationship to it. In the past, education has not been directed to disseminating knowledge that would develop responsible behaviour towards the environment. EE as a concept emerged in the 1960s and was generally accepted in the 1970s. This meant not only learning from or about but also for the environment.

Before then, the environment was viewed from an anthropocentric standpoint. The environment was hostile and had to be tamed. Knowledge was compartmentalized into what is commonly known as 'conventional' disciplines such as Biology, Chemistry, Geography, Economics, Psychology, History and Ethics. Each subject area isolated and treated specific environmental phenomena and no one was concerned with the whole. However, a few people became uneasy at the result of human interventions in the environment. It was also evident that nature does not really fit in conventionally tailored knowledge categories. This gave rise to new subjects such as ecology and/ or accompanied by deep rooted thinking on mankind's relationship with the environment. Emphasis was placed on the conservation of nature and natural resources.

At the postgraduate level there emerged environmentally oriented programmes such as Environmental Design, Environmental Management, Environmental Science, Environmental Studies and Environmental Engineering. These were reflected in new school subjects like urban studies, civics and social studies. Planning gained root as a profession that enhanced mankind's interventions in the environment.

In the 1960s there arose international concern about the degradation of the environment which was mainly expressed in terms of undesirable impacts of technology and economic activity. The industrial societies felt that they needed a type of education which would lead to economic activities and increased production with a minimum of environmental deterioration. The developing societies also showed an interest after being convinced that environment and development could be complementary. This concern and associated activities culminated in the United Nations Conference on the Human Environment held at Stockholm in 1972.

For the first time the urgency of the state of the environment both nationally and internationally was stressed and the need for a common outlook as principles to inspire and guide the peoples of the world in improving the environment was recognized. All governments and peoples were called upon to exert common efforts to achieve this goal.

Recommendation 96 of the Stockholm Conference called for the development of EE as one of the most critical elements of an all-out attack on the world's environmental crisis. It proclaimed that man was both the creature and moulder of his environment and had the capacity to transform it in many ways on a scale hitherto unknown. Furthermore, it declared that there was a close link between society and the environment and that the relationship was at a critical stage saying that "a point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences". In view of these ideas, it saw the role of education on promoting new perceptions to guide the new patterns of behaviour between mankind and the environment and between individuals in any society.

World Environment Day (WED) on 5th June each year was also initiated at the Stockholm Conference and has continued to be observed by many societies. On this day, a variety of activities concerning the state of the environment in each country and globally are carried out. These including parades, debates, plays, writing of poetry, the planting of trees, the screening of films and competitions of different types have been organized. It is sponsored every year under the direction of UNEP with active participation from the NGO's. UNEP has continued to stress co-ordination, co-operation and concerted action among all bodies concerned with the implementation of environment programmes.

In 1975, the Unesco-UNEP International Environmental Education Programme (IEEP) was initiated to promote EE. This led to the organization of the 'Belgrade Workshop' from which emerged the 'Belgrade Charter' which laid down the guidelines for EE. This world-wide co-operative programme was further strengthened by regional meetings of experts on EE in Africa (Brazzaville 1976; Lagos 1976), the Arab States (Kuwait, 1976), Asia (Bangkok, 1976), Latin America and the Caribbean (Bogotá, 1976), and Europe (Helsinki 1977). The climax was the Intergovernmental Conference on EE held in Tbilisi, Georgia, USSR in 1977. The Tbilisi Conference clearly emphasized that since EE was a new dimension in the existing curricula, it should be included as a component in all existing programmes and courses to reflect adequately all the environmental concerns of contemporary society as appropriate to the content and methodology of such systems.

To achieve this dimension, the conference outlined strategies for the development of EE at the national and international levels.

In content, the conference recommended that full coverage and emphasis be given to the teaching of ecological concepts and to the systems of the atmosphere, lithosphere, hydrosphere, biosphere and relevant social economic aspects. It should include the natural and social sciences and arts as the relationships between nature, technology and people mark and determine a society.

The Tbilisi Conference highlighted the importance of pre-service and in-service teaching and the preparation and development of teaching and learning materials. It stressed that this should provide a basis for training which would enable the teachers and educational administrators to incorporate the EE dimension effectively into their respective activities. Recommendation 17 states that Environmental Sciences and EE should be included in the curricula for pre-service teacher education while Recommendation 19 encouraged states to take the necessary steps to make the in-service training of teachers in EE available to all those who need it. It emphasized that the training should be done in areas where the teachers work and in co-operation with professional organizations of teachers at the national and international levels. Furthermore, the training should produce 'environmental integrators' skilled in the use of the interdisciplinary approach and methodology as distinct from generalists and/or specialists and include research methodologists for achieving the objectives of EE effectively.

The conference continued to emphasize the dissemination of information programmes and strategies through the use of mass media realizing the inadequacy of information changes. The Unesco-UNEP International EE programme exemplifies the start of international co-operation in this area.

The Declaration and the 41 specific recommendations emerging from the Tbilisi Conference provided a basic framework for future planning, improving and guiding national efforts in EE at various levels. They emphasized the need to infuse EE into the existing curricula, the use of mass media and community involvement and the initiation of environmental campaigns to increase public understanding.

In 1982, the 'Session of Special Character' was held in Nairobi, Kenya to celebrate the 10th Anniversary of the Stockholm Conference. The outcome was the Nairobi Declaration where over 103 nations re-affirmed their commitment to the Stockholm Declaration and Plan of Action.

Since the Stockholm Conference there has been an increasing awareness of environmental issues and problems and the need for EE both in and out of school has been recognized. What constitutes EE, its philosophy, goals and objectives and guiding principles are now well defined. However, much still remains to be done at all levels if the hopes expressed at the Stockholm, Tbilisi, and Nairobi Conferences are to be achieved. Hence, the challenge continues for the social science teachers and supervisions to take up.

Philosophy

Since the Stockholm Conference in 1972 two factors have been recognized. One is the need to come to grips with various environmental problems confronting countries as outlined in Chapter four. The second factor is the need for a new national type of development which recognizes and seeks an equitable distribution of the world's natural resources and a fair satisfaction of the needs of all individuals. Perceiving that the problems referred to and the type of development that has caused them have been perpetuated through the existing educational system (education being at the core of the development process) it follows that the education system should be re-oriented forthwith. It should achieve a new dimension that focuses on solving the environmental problems and evolving a new type of development with environmental constraints on what has been referred to 'Development without Destruction'. It should enable people to understand the complexities of the environment, make them aware of the consequences of their actions; and enable them to acquire an awareness, skills, attitudes, motivations and a commitment to the recognized needs for societies to adapt their activities to pursue their development in ways which are harmonious with development. Such an education is EE.

Through the development of new global ethics, it is hoped that EE will bring about a re-organization of national and global priorities to help societies to develop such that the environment which sustains them is enhanced or preserved. For, from the available evidence, the type and degree of environmental problems are closely associated with the levels of development or the lack of development. The following guidelines should be emphasized by the social science teachers and supervisors through EE:

1. Economic principles should be based on co-operation rather than competition. The cost benefit analysis of economic activities should be based on environmental principles and environmental considerations should be incorporated at the initial stages of all development activities such as development projects like the building of dams and initiation of irrigation schemes in developing countries. Both national and global economic principles should be in line with the new international economic order. Each country should produce citizens with the skills and knowledge, expertise as well as personal qualities not only to support a growing economy but to harmonize that growth with the specific environmental conditions.

2. Social goals should be re-oriented towards preparing the citizency for the changes in attitudes and relationships which are necessary for the smooth progress of a rapidly developing economy, as in developing societies, or the maintenance of a developed economy, as in industrial societies, to keep in harmony with the environment. The youth must develop an inquiring attitude towards traditionally established environmental values and be able to blend them with the changed requirements that must follow changing life styles in order to build a nation whose chosen model of development is sustainable by the environment.

3. Political Strategies. It is necessary for educational action to be linked with legislation policies, measures or control and the decisions that governments may adopt in relation to the human environment. For example, EE should foster that political goodwill which is essential to implement decisions arrived at in many national and international meetings on various aspects of the environment.

4. Religious Beliefs and Personal Ethics. EE adopts and encourages sound moral and religious values so as to help youths to grow up into self-disciplined, self-reliant and responsible citizens who understand their place in nature and who feel committed to maintaining that nature so as to improve the quality of life and the quality of the environment. EE provides opportunities for the fullest development of individual talents and personality. The foregoing is achieved through the choice of activities by the EE teacher, that help to bring out each aspect.

EE recognizes socio-economic and political influences in the evolution of technological innovations which enhance man's ability to exploit his environment. Hence it stresses the acquisition of knowledge of the environment in its totality and complexity. It takes a holistic approach and draws from all subject areas - the natural, social and human sciences as well as the arts. Such knowledge should encompass the wide definition of the environment as stated by the Belgrade Charter.

It is composed of the fundamental relationship that exists in and between the natural, biophysical world, the build communities and the social - political world. People will act accordingly towards the environment only after they understand its complexities. It has been rightly stated that all people are affected by environmental factors and hazards. A type of education has been formulated that will minimize if not eradicate these hazards as well as produce individuals who can make the right decisions in terms of their effects on the environment.

EE is a lifelong process. It is for all sectors of the population divided into two major categories:

1. The formal education sector. This includes the pre-school, primary, secondary and higher education level; teachers, environmental professionals in both training and re-training. This last group is needed for solving specific environmental problems and include, engineers, architects planners and others.

2. The non-formal education sector. This includes youth and adults, individually and collectively from all sectors of the environment such as family, workers, managers and decision makers in environmental fields.

Some environmental problems are global in origin or in effects. A co-operative spirit among nations is necessary for their solution. The need for a type of education with a role of helping to create an awareness of the social, economic, political and ecological interdependence of the modern world so as to enhance this spirit of co-operation, responsibility and solidarity among nations is evident. This co-operation will be difficult if the wide gaps and disparities in development both within and among nations remain. Such are poverty in developing nations especially in rural areas, concentration of development in urban areas whose population is the élite consuming most of the foreign exchange and reaping the benefits of economic growth and over consumption and wasteful lifestyles in industrial societies. There is thus a need for EE, a type of education that will at least attempt to bridge the gap by bringing about a new international economic order as visualized at Stockholm.

EE will bring about co-existence and co-operation resulting in the much needed international peace. International peace means an end to wars which are associated with environment degradation through devastation of both the natural and built environment. It will also mean an increase in resources allocated to provide for human needs as a result of cuts in military budgets.

EE is still being formulated and is bound to take time before it is streamlined.

Goals and Objectives

EE should bring about environmental action in individuals, communities, nations and the world. Hence, its overall goal is necessarily underlined by the goal of environmental action which according to the Belgrade Charter is:

'To improve all ecological relationships including the relationship of humanity with nature and people with one another'. Two environmental action objectives have been realized from this goal:

1. For each nation, depending on its cultural background to define the meaning of basic concepts such as the 'quality of life' and 'human happiness' in the context of the total environment and taking into account other cultures lying beyond its boundaries.

2. For each nation to identify the actions which will ensure the preservation and improvement of humanity's potentials and to develop social and individual wellbeing in harmony with the biophysical and built environment.

The words 'define' and 'identify' in this context should not be taken in the abstract but should both denote the commitment and an attempt to realize the above objectives.

The basic aim of EE then becomes 'to develop a world population that is aware of and concerned about the environment and its associated problems and which has the knowledge, skills, attitudes, motivation and commitment to work individually and collectively towards the solutions of current problems and the prevention of new ones'.

At Tbilisi this basic aim was divided into three goals:

1. To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas.

2. To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment.

3. To create new patterns of behaviour of individuals, groups and societies as a whole towards the environment.

To meet these goals it is necessary for EE to convey several basic concepts. These are:

1. The ecosystem is the basic unit of the ecospheres in which living things interact with the physical components and are interdependent with one another.

2. Most of our energy originates from the sun and flows through an ecosystem some being lost at each step till all available energy is gone. Hence the need for the conservation of energy. Materials are continuously cycled and recycled within and among ecosystems. As a result, in the natural cyclic system nothing is wasted. When people introduce artificial systems such as industrial processes, wastes are produced, pollution occurs and moves from one natural cycle to another.

3. An ecosystem has a carrying capacity, that is, the ability to support a given number of each species in it. If the components of the system are interfered with, then population stability will not be maintained.

4. People are part and parcel of the environment yet they have the greatest capability of altering the ecosystems by activities that reduce its ability to support life. The technology that they have devised to help them exploit nature can either be used to deteriorate or enhance the ecosystems.

5. The survival of mankind as a species depends on harmonizing their activities with the ecosystem processes. This can be achieved by developing a moral and ethical responsibility towards the environment.

The objectives of EE were summarized by the Belgrade Charter and endorsed at Tbilisi as the following:

(1) Awareness. To help social groups and individuals acquire an awareness of and sensitivity to the total environment and its allied problems.

(2) Knowledge. To help social groups and individuals gain a variety of experience in and acquire basic understanding of, the environment and its associated problems.

(3) Attitudes. To help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.

(4) Skills. To help social groups and individuals acquire the skills for identifying and solving environmental problems.

(5) Participation. To provide social groups and individuals with an opportunity to be actively involved at all levels in working towards the solution of environmental problems.

Guiding Principles

As stated elsewhere, EE is in the process of being. The Unesco-UNEP EE Programme has sponsored several activities on this line. However, many nations in both developed and developing nations have or are establishing EE programmes at the local and national level. These different programmes reflect the social, economic, political as well as the local natural environments and could therefore, be very different. This is also necessitated by the fact that while EE deals with global problems it also stresses local problems and citizen action. Possibilities of action present themselves at the local level. All such programmes if guided by the principles endorsed by the Tbilisi recommendation 2, will be essentially the same in principle though different in details. Such guiding principles are that EE should:

1. Consider the environment in its totality including the natural and built technological and social aspects (economic, political, cultural, historical, moral and aesthetic) and the correlations between them.

2. Be forward looking and a continuous lifelong process, beginning at the preschool level and continuing through all formal and non-formal stages.

3. Be interdisciplinary in approach, drawing on the relevant content of each discipline in making possible a holistic and balanced perspective so that interrelationships are studied and the community involved.

4. Examine major environmental issues from local, national, regional and international points of view so that students receive insights into environmental conditions in other geographical areas.

5. Focus on current and potential environmental situations while taking into account the historical perspective.

6. Promote the value and necessity of local, national plans for development and growth.

7. Explicitly consider environmental aspects in national plans for development and growth.

8. Enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences.

9. Relate environmental sensitivity, knowledge, problem-solving skills and values clarification to every age, but with special emphasis on environmental sensitivity to the learner's own community in early years.

10. Help learners to discover the symptoms and real causes of environmental problems.

11. Emphasize the complexity of environmental problems and thus the need to develop critical thinking and problem-solving skills.

These guiding principles reflect a definite need for both acquisition and transfer of learning in EE especially by use of '... diverse learning environments and a broad array of educational approaches to teaching and learning about and from the environment with due stress on practical activities and firsthand experience'.

To summarize, so far three different responses to EE as stipulated in this chapter have emerged. These are:

1. To increase development of environmental specialization within the traditional disciplines and professions. These include subjects such as Environmental Geography, Environmental Geology, Environmental Planning, Environmental Law, Environmental Economics and others.

2. To infuse environmental concerns in the many subject areas within the school curriculum. In this case it would involve all the social science subject areas.

3. To work across the disciplines and professions dealing with environmental phenomena and issues in an integrated or holistic way. This is the form that many post-graduate Environmental Studies Programmes have taken.

Chapter 2

ESSENTIAL KNOWLEDGE ABOUT THE ENVIRONMENT FOR SECONDARY SCHOOL, SOCIAL SCIENCE TEACHERS AND SUPERVISORS

Introduction

This chapter provides the knowledge component considered necessary for secondary school social science teachers and supervisors but essential as a base for the building of skills and the fostering of attitudes and values promoted by EE.

The chapter will explain the concept of the 'Environment' and then treat at a basic level the influence of mankind in the four spheres that comprise the environment. These are:

1. The Atmosphere - The layer of air that surrounds the earth.

2. The Hydrosphere - The waters of the earth's surface.

3. The Lithosphere - The rocks and soils that make up the earth's crust.

4. The Biosphere - The zone where all living things are found.

Definition of the Environment

The concept of the 'Environment' and the way in which it is perceived is closely linked with the concept of EE. It comprises the biophysical and socio-cultural aspects which are interrelated and interdependent parts of a complex whole.

Refer to Diagram 1.

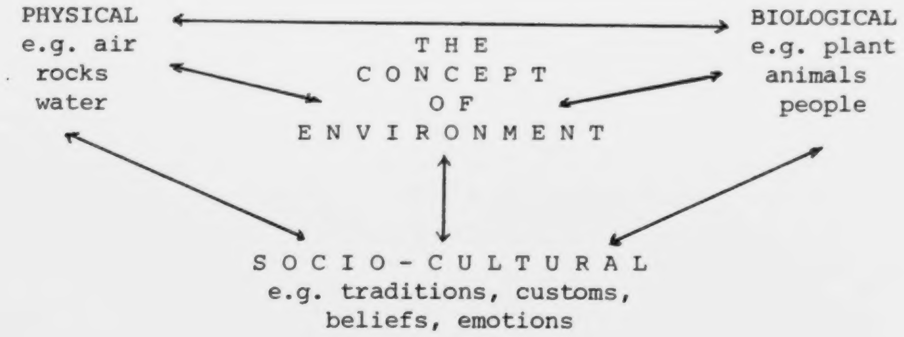


Diagram 1: THE NATURE OF THE ENVIRONMENT

The environment may be considered at the local, national, regional or global levels. To preserve and improve it, mankind must understand the environment and the consequences of humanity's use or abuse of it. Progress has been defined as an increase in the quality of life which in turn is determined by the quality of the environment necessary for sustained lifestyles in our present world.

The environment may be defined as '... the whole set of natural and social systems in which people and other organisms live and from which they draw their sustenance.' The natural environment is made up of four interlocking systems: the atmosphere (the belt of gases that surrounds the earth), the hydrosphere (the waters of the earth), the lithosphere (the rocks and soils of the earth's crust) and the biosphere (those parts of the earth where life exists). This is a dynamic situation as the natural elements are constantly changing but the nature and rhythm of such change is influenced by human activities. The social environment includes human groups, how they organize themselves and interact to satisfy their needs; the use of science and technology by people to exploit the natural resources to meet their basic needs of food, shelter, clothing, health, education, work and to control population growth and the rapid development of urban areas. The micro-urban environment with its material infrastructures should also be studied with particular reference to human activities such as industry and transport.

Thus the concept of the environment in its totality is a complex one, far ranging in its implications and challenging to our understanding.

1. THE ATMOSPHERE

As our existence depends on the atmosphere, its composition, extent and role should be studied. The air we breathe consists of a number of naturally occurring gases and may include natural vapours, particulate matter such as dust, pollen grains, salt and soot particles. It may be contaminated by noxious gases and fumes from industry and vehicular traffic. The composition of the earth's atmosphere is almost constant up to 100 kilometers in height and is outlined in Table I.

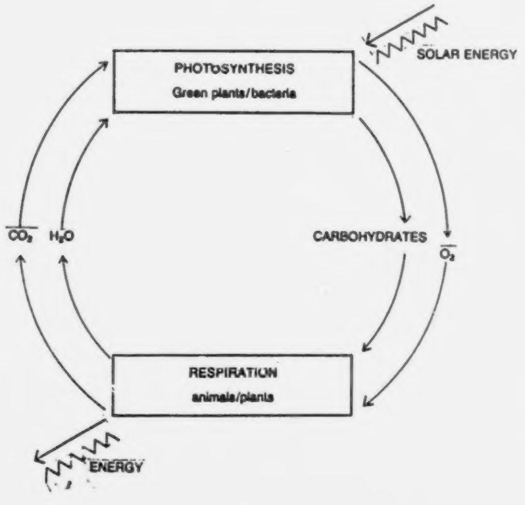
Table I: Composition of the Atmosphere

(a) Main Constituents		(b) Others	- Inert Gases in Minute Quantities
Nitrogen	- 78.03%	Ammonia	- in industry
Oxygen	- 20.99%	Helium	- in nuclear reactors
Argon	- 0.94%	Krypton	- rare gases
Carbon Dioxide	- 0.03%	Ozone	- oxidized oxygen
Hydrogen	- 0.01%	Xenon	- rare gas

and a small but variable amount of water vapour.

A knowledge of the uses of the atmospheric constituents is important to the life of plants and animals. Water vapour is essential to the formation of clouds, rain, hail, snow and dew. It forms part of the water cycle and acts as an agent to promote the rusting of metals which do not tarnish in dry air. Oxygen is the most active gas in the atmosphere and the dilution of pure oxygen is affected by nitrogen and argon which are chemically inactive gases. Oxygen is required for the oxidation of nutrients to release energy needed for all our daily activities. It is carried in the blood and used in respiration. Nitrogen is, along with carbon, hydrogen and oxygen, very vital in the formation of the basic materials for all life. It is fixed by bacteria and recycled by micro-organisms in the soil in nitrate form. Ozone is concentrated mainly between 13 to 15 kilometers upwards and absorbs much of the lethal short-wave solar radiation. It might also reflect heat back to the earth's surface. Carbon dioxide is very important because upon it depends the growth of all green vegetation and upon that the life of all animals who depend on plants either directly or indirectly for food. These include the plant eaters or herbivores such as zebras, cows, gazelles, the meat eaters or carnivores such as the lion, the cheetah and leopard and omnivores (those who eat everything) like monkeys. It is through food that living things get the energy they require for growth, movement and warmth. The process plants use to trap the sun's energy and convert it into food is known as PHOTOSYNTHESIS. The complementary process by which plant or animal cells are able to extract energy from food is RESPIRATION. These two processes which involve the use of air are vital to man. Refer to Diagram 2.

Diagram 2: PROCESSES OF PHOTOSYNTHESIS AND RESPIRATION



Carbon dioxide is produced during respiration and is used in photosynthesis. Its atmospheric concentration is increasing due to the rapid combustion of fossil fuels and deforestation. It is estimated that by the year 2000 A.D., there will be 0.04% of carbon dioxide in the air. This could result in altering the balance of the natural conditions by either raising or lowering the global air temperatures and the precipitation patterns with the resulting economic and social consequences.

Our immediate environment is the lower atmosphere from 1.0 to 1.5 kilometers thick with its winds, storms, variable rainfall and general fall of temperature with altitude. It is a zone with well defined climatic features determined by the rotation of the earth, the latitude, season, altitude and the distribution of land and sea. It is also the zone where pollutant concentrations are highest.

The atmosphere plays an important role in the life of plants and animals. As outlined earlier it provides gases for the processes of photosynthesis, it also has a 'greenhouse' effect by shielding the earth from the intense heat of the sun during the day and at night acts as a blanket to prevent the escape of heat thus providing a range of temperatures which living creatures can withstand. The atmosphere through the ozone layers protects us from the harmful short-wave radiation that could cause skin cancer and other genetic changes and also burns up by friction many meteors which every day fall into it from outer space. (Strahler, 1975)

The lower atmosphere influences weather and climate across the earth. Weather refers to the state of the atmosphere at any instant in time and the weather elements of temperature, relative humidity, precipitation, cloud cover, pressure, wind direction and speed are carefully measured by meteorological instruments and recorded. Weather changes so rapidly that in many parts of the world, reliance is placed on regular weather forecasts which can affect human plans and activities: for example, flying of aircraft, field investigations, the type of clothes worn and work done. Some parts of the world experience local atmospheric conditions which influence human activities. These include cold winds in valleys at night which can kill fruit crops due to their low temperatures.

Climate refers to the general state of the atmosphere over a period of time, usually 30-40 years. From a careful analysis of these meteorological records, atmospheric movements both vertical and horizontal are studied together with the stability and instability of air masses. The vertical and horizontal movements of the atmosphere together with the seasonal air movements, moisture content and air temperatures create discernible climatic patterns which are reflected in plant and animal behaviour and adaptations and can affect the whole way of life. For example, people living in the tropical rainforests have different forms of clothing, shelter, agricultural practices, economic development, history, traditions and cultures as compared to those living in arid and semi-arid areas.

It is necessary to consider man-induced climatic variations in a local area, particularly air pollution and its effects. It is vital to keep air pure. Otherwise the concentration or dispersal of air pollutants can lead to some societies incurring much loss and damage as has happened in some industrial societies. To some extent our nasal passages can filter out some particulate matter but this is limited. Constant exposure to poisonous gases such as nitric oxides, sulphur dioxide and carbon monoxide from industries and motor vehicles can accentuate respiratory ailments such as asthma and bronchitis endangering human health as well as lowering economic productivity. (Oliver, 1973)

Additional expenditure may occur from damage done to crops, materials, buildings and monuments of national interest. For example, the deterioration of marble in historical monuments such as the Acropolis at Athens and the Taj Mahal in India.

Clean air is so important for survival, hence the need for a knowledge of the atmosphere, its properties and how it relates to the rest of the habitat. With this understanding, social science teachers and supervisors can exert all efforts to maintain the quality of the atmosphere, one system of our environment.

2. THE HYDROSPHERE

The hydrosphere is the next interlocking system in the natural environment. It comprises the waters of the earth. Water is essential for life and is a vital natural resource. Three-quarters of our bodies are made up of water and it supplies hydrogen for organic compounds in photosynthesis and oxygen to the air. When water freezes, ice forms on the top of the pond or lake and life continues beneath. Water is a solvent for the mineral nutrients which are only available to plants in solution.

Most land plants absorb water through the roots. If the rate of water absorption is insufficient, the plant will wilt because it is in a state of 'physiological drought'. Plants must have the capacity for allowing sufficient moisture to pass through it or for protecting itself against excess water loss. In fact, the relationship of water supply to land plant forms is so important that plants may be classified as in Table II.

Table II: Type of Land Plant Forms in Relation to Water Supply

TYPE	EXAMPLE	TECHNICAL TERM
Plants growing in water	water lilies e.g. ponds, lakes	HYDROPHYTES
Plants growing in waterlogged soils	mangrove trees e.g. tropical wastes lagoons	HALOPHYTES
Plants growing in transitional zones	date palm e.g. oasis in deserts	MESOPHYTES
Plants adapted to drought in various ways	cacti, laurel e.g. arid and semi-arid areas	XEROPHYTES

Few plants can tolerate a reduction in cell water content so that special means have to be found to acquire more or to retain what is held. Some plants prevent water loss in transpiration by having small waxy leaves like conifers whilst others like the cacti conserve water in thickened stems.

Water is essential to animals who can obtain it by moving to a source of supply such as the water holes in the savannah of Africa which attract a variety of plant eating animals. Desert animals live in holes where the loss of body fluid is reduced. Water availability can be a limiting factor on distribution of species.

70% of the human body consists of water and two litres is required daily to replenish the water lost through everyday activity. People use water for domestic purposes, in industry, transport and agricultural activities.

A knowledge of the distribution of water is required. For, although water is the most abundant liquid in the environment, yet not all of it is available for use. About three-quarters of the earth's surface is made up of water but over 96% is salt water in oceans and seas, 2% is frozen in ice-caps and glaciers and much less than 1% is FRESH water needed by people to sustain life, health and productive activities. 70% of this fresh water form surface supplies in lakes or rivers, waterfalls and the atmosphere. This source is widely used by us in all our activities. 30% consists of ground water in aquifers, hot springs, steam jets and geysers and wells. This source is used in arid areas like Western Australia and in the Sahel but its rate of usage generally exceeds the rate of replenishment unless careful management is practised.

In nature, water is in a permanent movement from land to the sea (run-off) to the atmosphere (evaporation and evapotranspiration) and back to the land as precipitation. The principal pathways of water through the major systems of the earth is known as the watercycle. Refer to diagram 3. There are variable time delays in these exchanges. For example: precipitation in the form of snow can remain for months as in Iceland.

Diagram 3: THE WATER BALANCE OF AN AREA

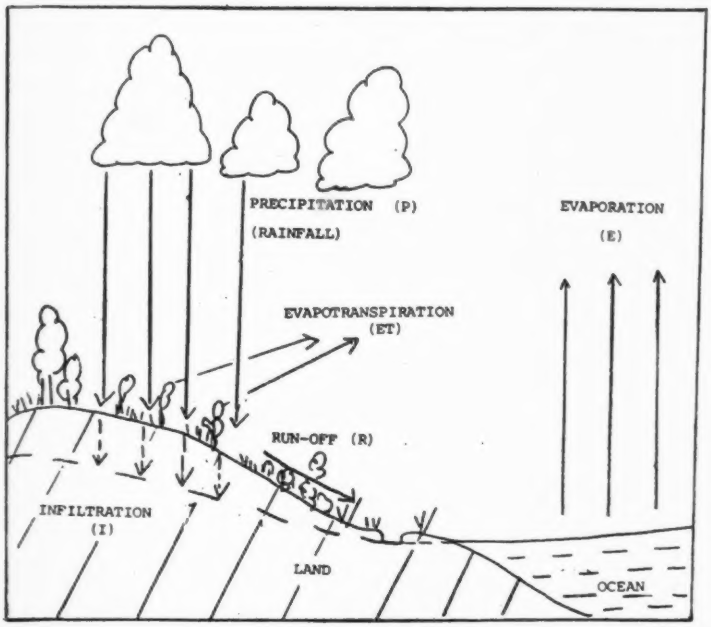
P = ET + R + I where

P = Precipitation

ET = Evapotranspiration

R = Run-Off

I = Infiltration



The water cycle does not create new water; it only recycles it. Whilst the distribution of water varies in space and time, the total amount of fresh water remains fixed. (Holgate, Kassa, White, 1982). In fact, mankind has the same water that it had 1000 years ago yet demands on this resource continue to soar with population increase and rising living standards. Through human activities such as deforestation, building of dams and reservoirs and pollution, the water cycle has been interrupted leading to shortages of one kind or another, very evident in a river basin environment, where some of the major civilizations evolved.

The water contained at any moment in river channels is very small but locally important for drinking, irrigation, navigation, fishing, power and industry. In such a unit, there is a need to assess the overall water resources and draw up a water balance. This is the relationship between the water gains of the soil-plant belt of the basin from precipitation (P) and the water losses from the same area through evaporation (E) surface run-off (R) and infiltration (I). Imbalances in the water balance situation can arise with serious effects on the environment and the people who live there. If P exceeds E + R + I floods occur. If P is less than E + R + I droughts occur as the Sahelian drought with disastrous consequences for the nomadic communities. There is a need to understand and be able to work out the water balance of any area prior to any development. Maintaining the natural water balance of a river basin means maintaining the ecological balance of the area. In addition, the scale of the river basin, the history of its occupation, the varied topography of the catchment area may affect the nature and outlook of its inhabitants. If not properly managed a diversity of human activities develop leading to the deterioration of the environment as in the Danube, Nile and Rhine catchment areas. The International Rhine Pollution Commission in 1973 recorded that sewage, salt, hot water and chemicals were, rapidly making river Rhine an 'International Sewer'.

It has been found that the best use of the resources of a river basin is likely to be achieved by integrated planning such as the TVA in the USA, the Sokoma River Basin in Nigeria and the Kerio Valley Development Authority in Kenya. The control of surface run-off and water has been the pre-requisite for human settlements in many different environments. In addition, it has become necessary to treat water before and after use. For clean water is easily contaminated by human and industrial wastes and affects development because of the effects on human health and reduction in work efficiency and productivity. People are frequently unaware of this danger. According to the World Health Organization, 80% of all sickness and disease in the world can be attributed to water and sanitation or lack of it. Common water borne diseases that today afflict many societies in the developing world include cholera, bilharzia and hookworm. Many of these diseases can be minimized by improvement in the environmental conditions of an area. These efforts are now intensified through projects in the International Drinking Water Supply and Sanitation Decade, 1981-1990 (UN 1980).

Water quality has been affected by three factors:

1. The introduction and explosive spread of aquatic plants such as the Salvinia molesta (a free floating seed) in lake Kariba in Zambia and lake Naivasha in Kenya, (El-Hinnawi, 1980).

2. Over-enrichment of the waters due to the excess chemicals from drainage containing agricultural fertilizers and domestic sewage. An example is the well documented case study of lake Erie, (Lake Erie Symposium, 1976.

3. Pollution from urban and industrial discharges have had a marked effect on water quality. The impact of acidification in the Scandinavian rivers and lakes is an example, reducing the productivity of these ecosystems, (Dickson 1975).

Toxic substances and heavy metal such as mercury can accumulate within the tissues of a species such as fish used as food and cause health hazards to human consumers as revealed by the Minamata case in Japan, (Ui, 1969). Some of these contaminants may not only harm people individually but may each react with the others to produce harmful substances like the cumulative effects of bad poisoning. The need to plan for management of water resources on a local, national and international scale towards wiser more stable water use and control is stressed.

A knowledge and understanding of the characteristics of the oceans and seas and their use is important as the marine environment determines the productivity of fisheries, the dispersion of pollutants, the availability of mineral resources of the sea-bed and the numbers and variety of marine animals.

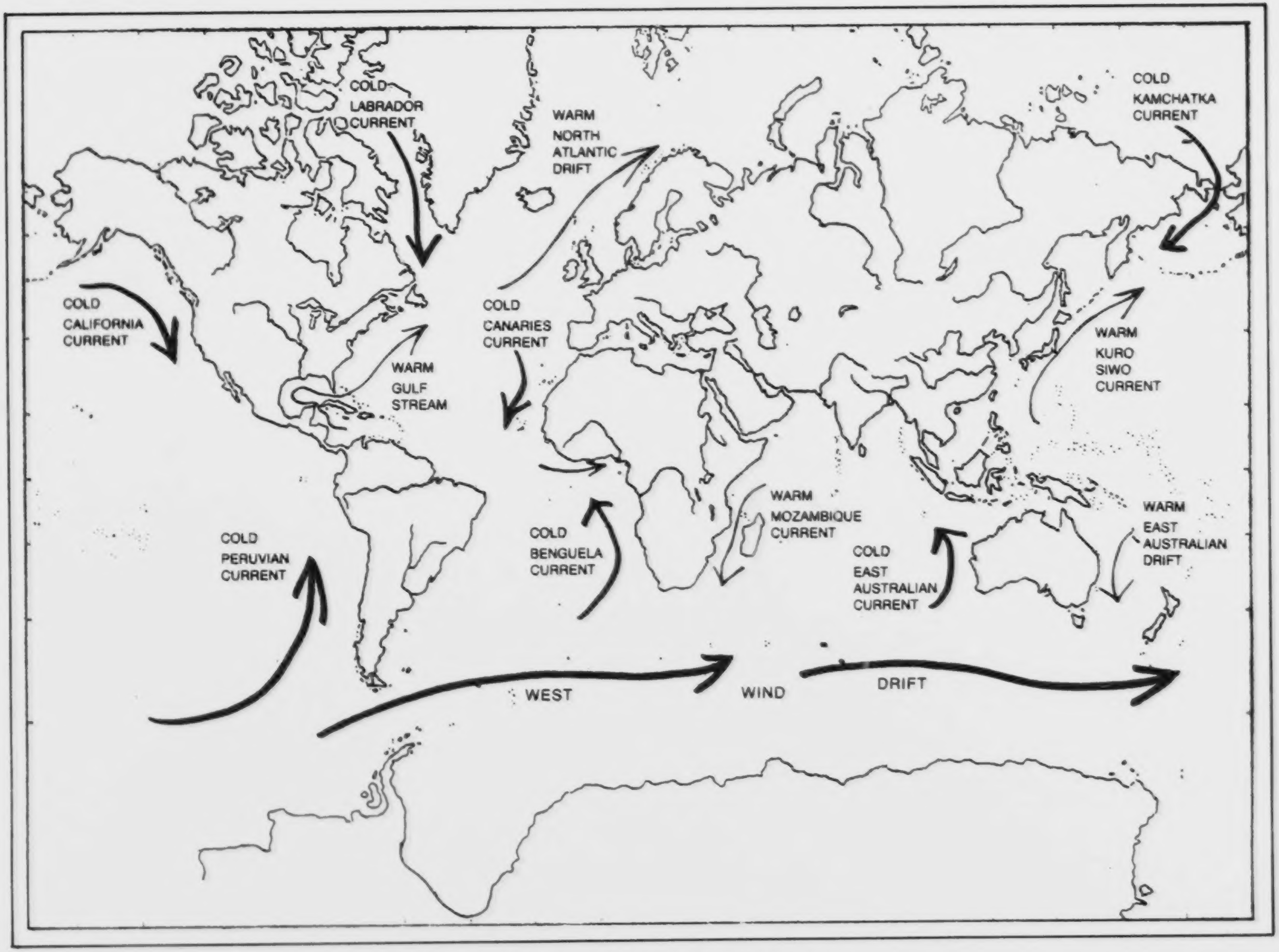
Oceans provide one-fifth of the world's annual protein and can help to supplement the world's food supplies. Aquaculture has greatly expanded in China and S.E. Asia while in the USA it is responsible for 60% of the total commercial fish catch, (Holdgate, Kassas and White, 1982). Our fishing has resulted in the depletion of fish stocks such as the Peruvian anchoveta and the North Atlantic herring populations. Tight controls may assist in the recovery of these fish stocks.

The physical and chemical properties of the oceans determine their capacity to receive and disperse pollutants. Those of the greatest concern are due to sewage, agricultural chemicals, oils and metals. The transport of pollutants and their rate of dilution or deposition in sediments is determined by the motion in the oceans at all scales from the oceanic to the molecular.

The overall chemical contamination of the oceans appears localized with the worst conditions in shallow, coastal waters, estuaries and swamps in industrial regions where ecological changes are apparent. These waters are not only the breeding and nursery grounds for fish species that are commercially important off-shore but are areas where human influence is dominant and where damages from pollution and changes in the use of coastal waters are concentrated. The monitoring of these ecosystems and pollutants is carried out in selected localities like the Mediterranean Sea under the UNEP Regional Seas Programme. The tightest controls should be introduced for artificial pollutants such as DDT and nuclear wastes which the seas cannot break down and absorb, (UNEP, 1980).

The technological advances made in the 1970s in the exploitation of the mineral resources of the sea-bed seem likely to continue. Off-shore oil and gas production as in the Persian Gulf, the Indonesian waters and the North Sea, accounted for 90% of the value of mineral resources recovered from the sea-bed. The impact of such mineral exploitation by the construction of off-shore structures such as platforms, well-heads and pipelines restrict fishing activities and may also lead to the local redistribution of fish populations.

Concern has been expressed for the conservation of marine animals especially whales, porpoises, seals and polar-bears, who have all been subject to severe hunting. It has been suggested that the larger whales that have formed the basis of the commercial fishing industry in the North Pacific and the Southern Hemisphere have almost been driven towards extinction. Only 48% of the total stock of these whales remain. In 1975 the International Whaling Commission implemented a new management procedure to conserve these marine resources, (World Conservation Strategy, 1980).



Map I: Oceanic Circulation of the World

Transportation and associated operations constitute a major use of the oceans but can increase oil pollution either by major accidents or through persistent chronic pollution at specific localities as in the Red Sea and the Gulf of Aden, forming a potential threat to marine life and habitats, (Gesamp, 1980).

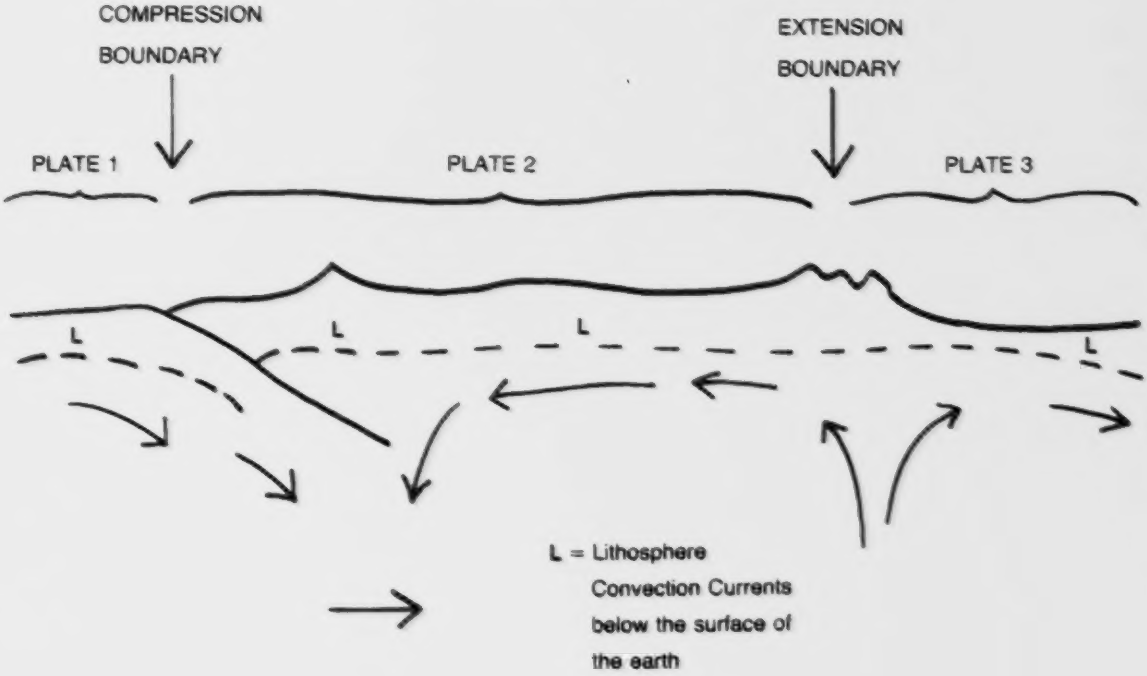
The desalinization of the sea and brackish water especially in arid and semi-arid areas went into large scale operation at a few favourable sites such as Hong-Kong and Kuwait.

The maintenance of the quality of the hydrosphere is essential to the well-being of human societies and such attitudes need to be encouraged by the social science teachers and supervisors particularly where short term economic interests overide long-term ecological interests. The hydrosphere not only provides us with water but also plays an important part in the transfer of heat energy polewards from lower latitudes, through moving air masses and ocean currents. For example, the Gulf Stream transfers warm water to higher latitudes. Refer to Map 1.

3. THE LITHOSPHERE

The lithosphere together with the atmosphere and hydrosphere combine to shape the landforms, create soils and help support a vast biotic life. The lithosphere refers to the outer crust of the earth which is made up of lighter rocks and is broken up into plates. This overlies denser material. The crust is thicker under the continents especially the high mountains between 30 and 75 kilometers and is driven beneath the oceans, from 6 to 8 kilometers. The continuous movement of the surface plates subsequently cause the destruction and rebuilding of surface rocks. According to the plate tectonics theory, where two crustal plates move apart at the extension boundary earthquakes, faulting and volcanic activity occur as in the eastern rift valley of Kenya or along the San Andreas fault in California. Where the plates move towards each other as at the compression boundary, folding occurs, (Bradshaws, Abbott and Gelsthorpe, 1978). Refer to diagram 4.

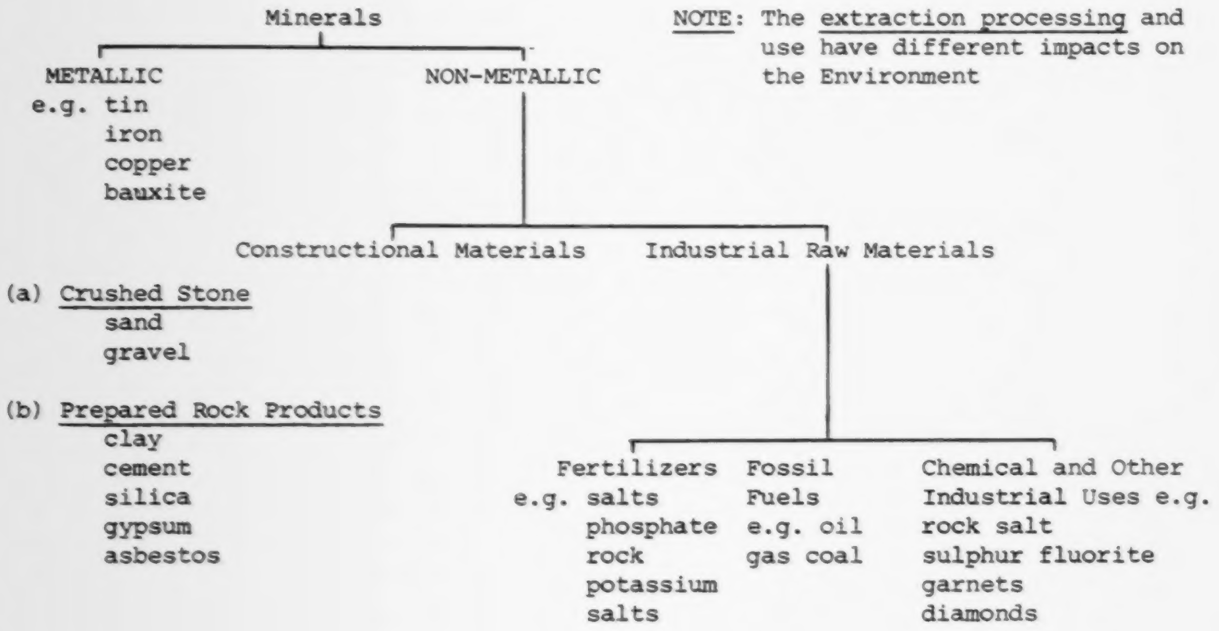
Diagram 4: Plates and Plate Boundaries



These processes result in a variety of physical landscapes which are further modified by weathering and erosion and which support a range of plant and animal life.

A diversity of rocks not only produces varied relief but also a variety of minerals. Refer to diagram 5.

Diagram 5 Types of Minerals and their Impact on the Environment



NOTE: The extraction processing and use have different impacts on the Environment

Minerals not only provide us with raw materials for construction, industry and as a source of fuel but are important in international relations from two points of view:

1. The need to have access to strategic minerals by individual countries.

2. The part played by minerals in the North-South dialogue between industrial and developing countries in the New International Economic Order to establish equity between nations.

To understand the nature, occurrence, distribution of mineral resources and the impact of their exploitation, processing and use on the environment, a knowledge of the origin and types of rocks is required.

Rocks are composed of mineral particles and vary in their influence on the development of landforms. Some rocks like granite are hard and resist erosion while others like clay are soft and more easily worn down.

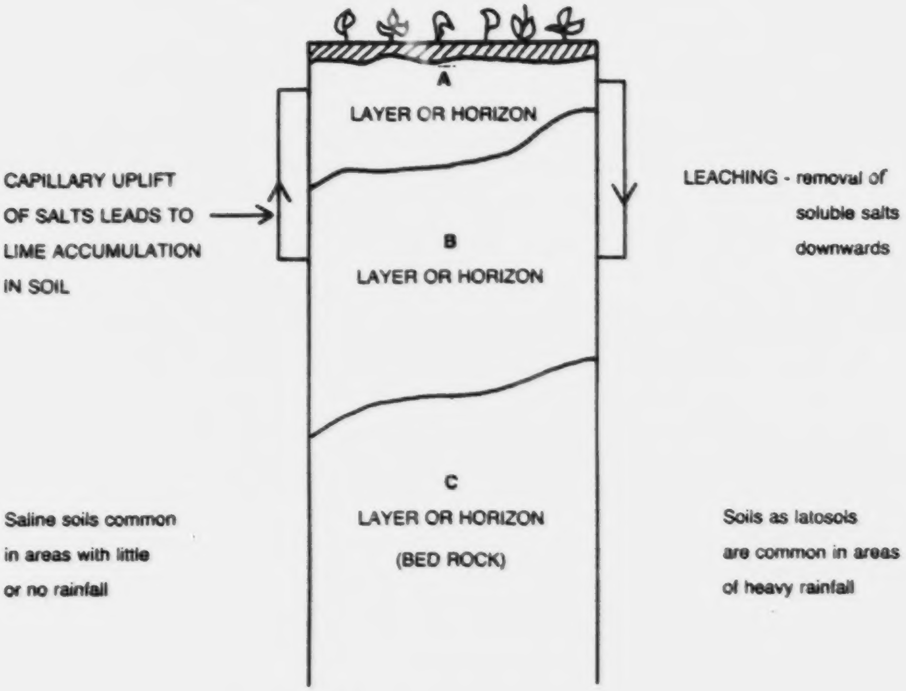
Rocks may be classified into three categories by their origin. Igneous rocks originate either by cooling from molten magma below the crust to form intrusive rocks like gabbro and granite or pierce the earth's crust to cool on the surface as lava. Sedimentary rocks originate from the compaction and cementation of sediments deposited on the sea-bed or in lake basins. These rocks generally show a layered arrangement and include rocks such as gypsum, chalk, rock salt, muds, clays and fossil fuels of ancient organic matter. Rocks changed by heat or crustal pressures long after they have been formed are termed metamorphic rocks and include marble, slate, quartzite and gneiss. The change is essentially of the physical characteristics whilst the chemical composition hardly changes. For example, marble is the altered form of limestone, while quartzite is metamorphosed sandstone, (Press, Siever, 1974).

Once these rocks have been exposed at the surface, they are subject to weathering, which is the disintegration and/or decay of solid rock involving little or no movement. The processes of weathering vary with the location. In high altitude areas frost shattering is common compared to mechanical disintegration in arid lands whilst chemical weathering is more dominant in humid areas, further assisted by the action of plants and animals.

The loose weathered material is then removed by creep, slumping or sliding downwards under the force of gravity or by agents of wind, water, ice and the sea and which deposit the weathered materials elsewhere as new features. Weathering contributes largely to the formation of soils and at the same time the organic processes essential for soil formation may accelerate the weathering of the bedrock.

Soil is the most important part of the land biosphere. It forms the basis of food production and provides man with a variety of raw materials for food, clothing and building. To conserve and manage this resource for future generations, it is essential to understand the origin and nature of soil, its potentialities for growth and the best possible land-use. For example, what are the best soils for farming, housing, factories, forests and recreational uses? Soil is broken down material which is acted upon by atmospheric processes bringing about chemical and physical changes dominated by the movement of water through the soil. In areas of heavy rainfall, this downward movement of water with the soluble salts is known as leaching while the upward movement of water by capillary action occurs in dry lands resulting in distinctive soil characteristics. Refer to diagram 6.

Diagram 6: Processes Operating in Soil Development



Organisms living in and on the soil also modify its nature so that the original mineral matter becomes mixed with organic waste and decomposition products. Both are re-arranged by movements taking place within the soil environments. After a time, the soil is arranged in layers, or horizons related partly to the parent material but more closely to the internal movement of water which is associated with the local conditions of climate, relief and vegetation cover.

The arrangement of the soil in well differentiated layers is known as a Soil Profile. This is well developed in mature soils such as Podzols, (ash-grey soils) Chernozems (black earths) and Tropical and Red Brown Earths, unlike immature soils such as alluvial or volcanic soils which have not had time to develop mature profiles. Each soil has certain characteristics which can be defined in terms of the following:

1. Colour: black or dark brown soils usually have a high content of humus whilst light grey soils have little. Iron compounds give red or yellow colours to soils. The Munsell chart indicates the standard colours commonly found.

2. Soil texture: this refers to the size of the particles that make up soil. It could be coarse or fine and determines the resistance or otherwise of water movement through the soil.

3. The mineral nutrients required by plants. Different crops require a different balance of soil nutrients. Generally, soils must be able to absorb sufficient of the soluble compounds of three main nutrients - nitrogen, potassium and phosphorous. Other elements are also essential and must be in a form which plants can absorb. For example, there is a delicate balance between the various metals - an excess of one may prevent another being taken up by a plant. Such balances in soil as well as aspects of soil content and structure are studied by soil scientists.

4. Soil structure: this refers to the way in which the soil grains are grouped together in larger pieces held together by clay particles, which hold in the mineral nutrients. A soil with a high proportion of clay matter will be formed of large cohesive structures and will contain a high proportion of mineral nutrients. This makes the soil basically fertile but ploughing and the careless use of chemical fertilizer can break down the soil structure.

5. The acidity or alkalinity of soil is measured by the pH and it is a good measure of soil fertility. Some crops like tea like acid soils which have a low pH whilst others do well in alkaline soils where the pH is high. The acidity of a soil can be modified by the addition of lime. In all cases a balance is recommended as the soil is a natural resource which cannot be replaced if destroyed. Moreover, it is closely related to all factors affecting the biosphere, that is, the underlying rock type and relief, climate, vegetation and animals all of which are in a delicate state of balance. Refer to Table III.

The topsoil is the growing medium for plants and is a definite environment within the biosphere while the subsoil is merely broken down rock.

Such knowledge of soils is needed to safeguard, improve and conserve soil, the most mismanaged resource on this earth, (Kovda, 1977). Human activities such as improper use of the land, felling of trees, overgrazing and monoculture, have accelerated the process of soil erosion leading to desertified areas (Unesco, 1981).

As a result, mankind has devised a variety of soil conservation methods such as building of terraces, filling in of gulleys, use of gabions and crop rotation, planting of trees and windbreaks to halt, correct and prevent the rapid loss of soil.

4. THE BIOSPHERE

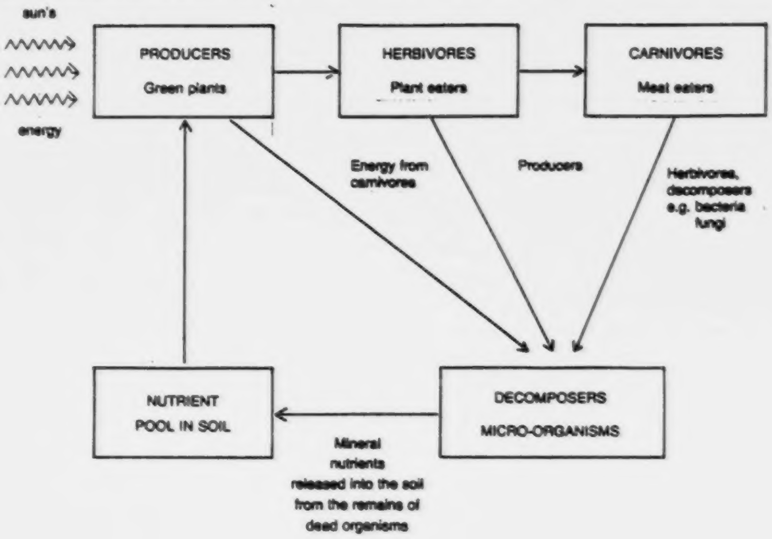
This is the fourth system in the environment and the zone where all living things - plants, animals and people are found. It is a region of abundant water, mineral and gaseous reserves. It is a shallow zone being a few meters deep on the continental surface and a few kilometers deep in the oceans but with an immense variety of living species numbering between two to four millions species and over 4,000 million human beings.

A knowledge of the biosphere is essential if development without destruction is to be achieved. It is evident that people have increasingly modified the life on earth, changed the distribution of species and the nature of the ecological interactions between them. Many of theses changes are an essential component of development. Some changes have been positive such as in South East Asia where land has been enhanced by traditional techniques of terracing, water application and fertilization. When development has been hampered by poverty or driven by great need, the fertility of the land and the stability of the soils have been jeopardized. Due to ignorance or to the seemingly unlimited bounty of natural resources, human activities such as the felling of trees, use of fertilizers and pesticides, oil spills and the increasing pollution of genetic resources have alerted mankind to the need for the conservation of these resources and their most effective utilization.

To enable proper action to be taken, there is need to highlight and appreciate the interrelationships of living organisms with each other and with the physical environment. A unit where these relationships are studied is known as ecosystem. There are many types of ecosystems. Some, such as tropical rainforest, savannah, grasslands, coniferous forests and tundra are terrestrial ecosystems whilst ponds, lakes, oceans are examples of aquatic ecosystems. In these ecosystems minute or large, living things have evolved through geological time and are constantly adapting to the changing environments having a marked effect on the soils, rocks, oceans and atmosphere, (Smith, 1972).

The ecosystems function by the flow of energy and nutrients passing through them. Refer to diagram 7.

Diagram 7: ENERGY AND NUTRIENT CYCLES IN AN ECOSYSTEM



In the biosphere almost all energy is from the sun. There is an energy flow from solar radiation through plants to herbivores, then to carnivores, omnivores and micro-organisms in food chains or food webs. A simple food chain on land might be represented by:

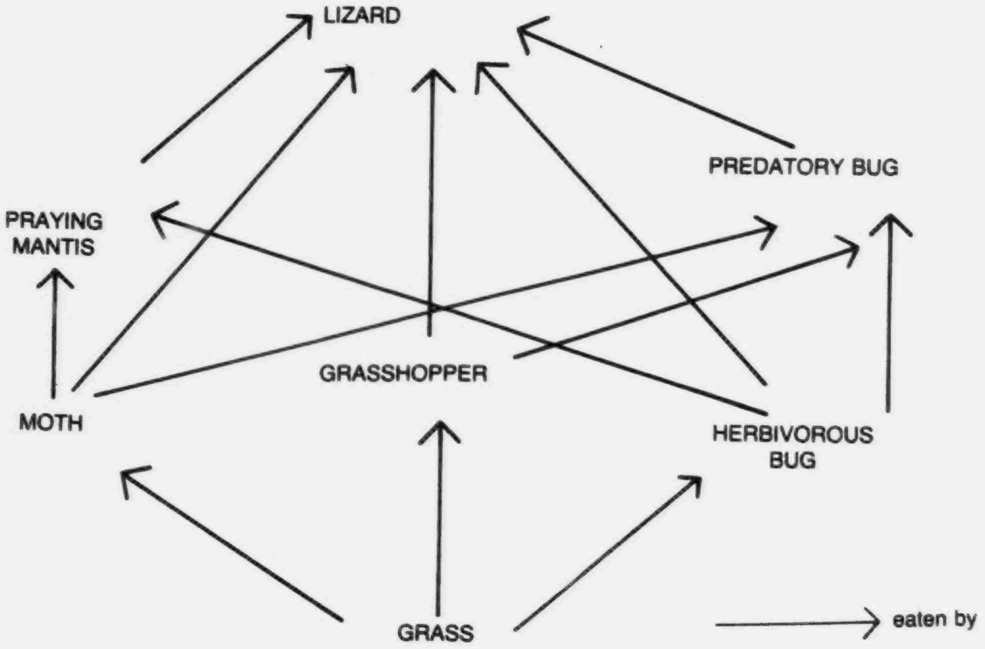
GRASS → INSECT → TOAD THREE LINK FOOD CHAIN

A simple food chain in water might be represented by

PHYTOPLANKTON → INSECT LARVAE → SMALL FISH → LARGE FISH — FOUR LINK FOOD CHAIN

The most efficient transfer of energy occurs in a food chain that has fewest links. Where consumers feed on several different organisms as in the savannah of Africa a food 'web' results with inter-linked food chains which make for stability within the ecosystem. Refer to diagram 8.

Diagram 8: A Food Web in the Savannah



Plants have a fundamental role to play in making the nutrients available to living organisms. Only plants can transform solar energy into a form which is available to organisms and only plants take up chemical nutrients and incorporate them into organic material. Many of these chemical nutrients pass through rocks, the atmosphere, water and living creatures in circulating or biogeochemical cycles such as water, carbon nitrogen, sulphur, oxygen and phosphorous cycles, (Odum, 1975).

The cycles of greatest practical importance will be those involving elements which are rare in rocks like phosphorous or which form very soluble compounds like nitrogen which may be easily worked out of soils. Supplies of these two chemicals are often deficient in nature and hence have to be artificially supplied.

Many of these cycles are inter-related. If undisturbed, they continue to operate continuously so that a sufficiency of the materials that circulate is ensured. In the natural state, there seems to have been some regulation of the circulation of these vital nutrients and the composition and forms of animals and plants which are related to the particular availability of certain nutrients in the environment. People interfere with these cycles by the addition of artificial fertilizer, weed-killers, pesticides and waste effluent which pass through the animals with tragic results and can have repercussions on the biosphere at large. For example, the run-off from farm lands has resulted in the 'overfertilization' of some lakes causing instability in this ecosystem and affecting the life of the people who live along the lakeshores.

The most stable situation is that of the climatic climax which is characterized by complexity and diversity. Forest represents the natural climax vegetation of at least 6 million hectares of the world but it is estimated that since the mid-twentieth century, the world's original forested areas has been reduced by at least 33% and possibly by as much as 50%, (Myers, 1979).

In any planning for development there is need to consider the whole ecosystem and not isolated parts of it. The introduction of animal species in new habitats such as the rabbit in Australia caused extensive damage to the natural vegetation and wildlife and economic loss of major proportions through competition with domestic stock. Similar cases can be cited of the red deer in New Zealand and the mule deer in the Kaibab National Park of the USA, (Dasmann, 1976).

Ecological instability can also result from attempts by people to simplify food webs. For example by planting a single crop to replace the many grains, herbs and shrubs of a natural community as in a coffee plantation or replacing the different species of wildlife by large herds of cattle, sheep and goats to feed the rapidly growing population. Such activities can lead to disturbances of soil balance, accelerated soil erosion, destruction of plants, vulnerability to pests and diseases and an overall decline in productivity. To minimize these risks, management techniques now include game ranching and cropping.

It is encouraging that increasingly ecological principles are now being considered in the eradication of crop pests and in the management and planned utilisation of living resources in terrestrial and aquatic ecosystems. This trend has been further strengthened by the launching and adoption by governments of IUCN/UNEP/WWF World Conservation Strategy (WCS).

Conservation measures to protect and to enhance the productivity of the biosphere have been the concern of all peoples in the last 100 to 150 years and culminated in the WCS in 1980. The recurring theme was that sustained economic development cannot proceed without the conservation of living resources. It considered the human impact and the changes that may threaten the future of the world's life support system. It defined three global objectives of living resource conservation:

1. To maintain essential ecological processes and life support systems.

2. To preserve genetic diversity.

3. To ensure the sustainable utilization of species and ecosystems.

Conservation activities included the safeguarding of soil, the enhancement of biological productivity by irrigation and drainage, and the improvement of plant species and livestock by breeding programmes. Since 1972, many of the recommendations made at the Stockholm Conference to conserve natural resources, have been implemented. Furthermore, the number of UN Conferences held on food, water, EE, deserfitication, science and technology have helped to increase the levels of awareness and stimulate ACTION.

It is increasingly evident that societies with their science and technology, traditions and customs must function within the limits of the biosphere to ensure their future survival. Otherwise, they might be forced to carry complex life support systems like the Apollo astronauts were compelled by the absence of any biosphere on the moon.

To function within these limits of the biosphere, it is necessary to study the form, structure and pattern of development of human societies as these affect the use of the environment and have bearing on the environment problems, faced by any society.

As population is at the root of many environmental problems a knowledge of the major demographic trends is important. There is need to consider the size, rates of growth, distribution, the age-structure of the population and their implications for development.

In 1980, the world population was 4,400 million, an increase of more than 700 m over the world population in 1970, (UN, 1980). Refer to Table III.

Table III : WORLD POPULATION 1900-2000

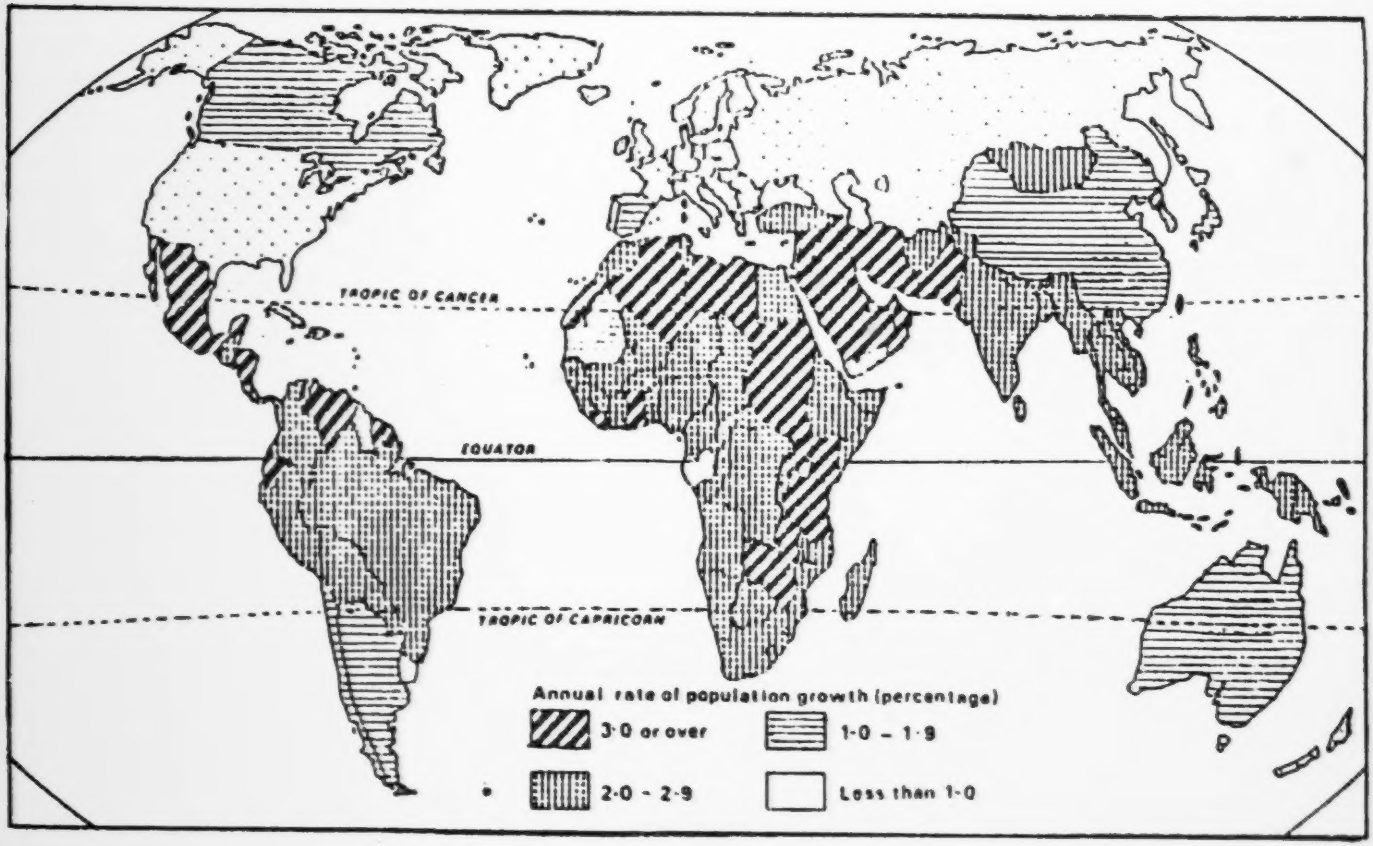
Year	Population (millions)
1900	1,500
1960	3,000
1980	4,500
2000 (prognosis)	6,000

Population growth occurs as a result of natural increase, that is, an excess of births over deaths or migration. The world growth rate decreased slightly to 1.72% and varied from 0.6% p.a. for developed countries to over 2% p.a. for the developing societies. Even among the developing countries, growth rates varied considerably with Africa being the fastest growing continent followed by Latin America. Refer to Map II. After World War II, the death rates fell rapidly as a result of health programmes but the birth rates continued high in developing societies and fell in developed societies. Refer to diagram 9.

Three quarters of the world population live in the developing world and it is believed that by the year 2000 A.D., the proportions will increase. There are two aspects to be observed about the populations in the developing societies.

First, as a result of the high fertility rates and the improved survival rates for infants, many of the people of developing societies are young; over 50% of the population being under 15 years of age as in Kenya while in developed societies, very large increases occurred in the numbers of persons above age fifty five as in Sweden, (UN, 1980).

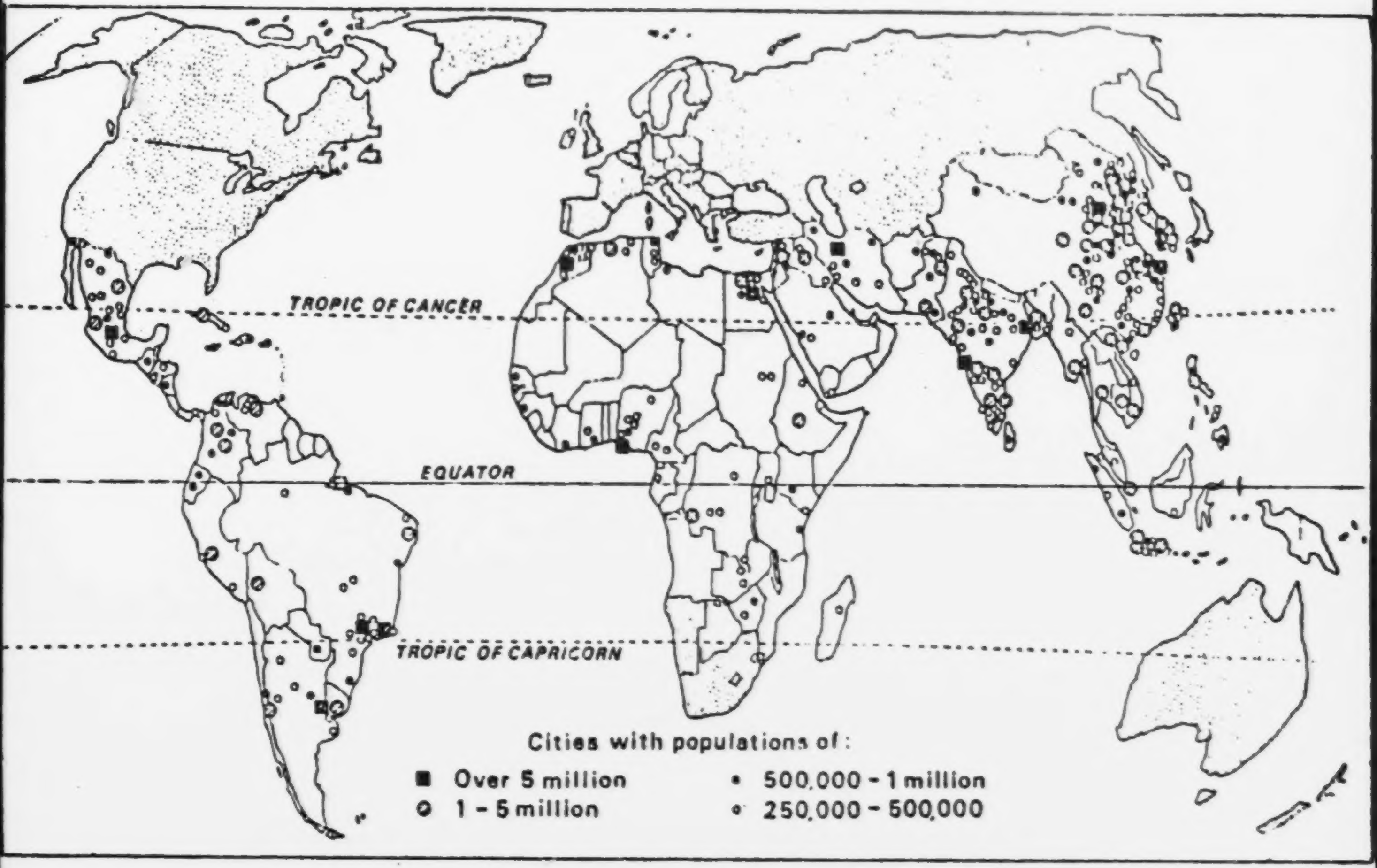
Although much of the population live in rural areas, farm to city migration led to rapid urbanization on a scale and at a rate never experienced before. The direction of urban growth was towards large cities.



MAP II The growth of population in different countries 1978

(From Dickenson et al 1983)

MAP III   Gives an Indication of the MAJOR CITIES in the THIRD WORLD COUNTRIES



MAP III   THIRD WORLD CITIES of over 250,000 inhabitants

(From Dickenson et al 1983)

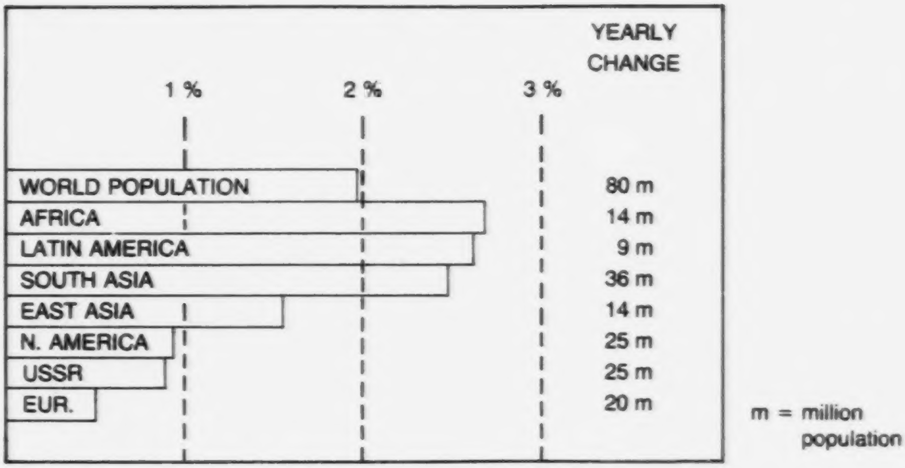
It is suggested that by 2000 A.D., developing countries will have 61 cities of more than 4 million compared with about 25 in developed societies. In 1960, there were only 8 cities of over 4 million population in the developing world as compared to 10 in the developed areas. Refer to Map III.

Rapid expansion of large cities took place against a background of higher population growth and low incomes (World Bank, 1979). It outstripped the countries' abilities to provide both adequate accommodation and services and led to slums and squatter settlements around the perimeters of large cities. One third of the urban population in developing countries is believed to live in such shanty towns lacking safe water, waste disposal facilities, decent housing, adequate transportation and other facilities. Between 1972 and 1982, squatters made up 45% of the population of Ankara, 35% of the population of Caracas, 30% of the population of Karachi and has continued to increase, (Abrams, 1974).

This process poses problems of the need for employment and housing, implications for industry, and the rising demand for public and other educational, health, sanitation and transport facilities. The situation has been worsened by the problem of refugees which place a strain on the resources of the receiving country and result from the effects of war and political upheavals rather than environmental adversity. From 1980-82, an average of at least 2,000-3,000 more people became refugees each day throughout the world. (Brandt, 1980).

Despite the urbanization process, over 58% of the population in developing countries still live in rural areas, where rapid population growth has led to the increased demand for food and fuel leading to deterioration of the environment.

Diagram 9 : THE POPULATION GROWTH IN DIFFERENT PARTS OF THE WORLD



The plight of the dwellers in slum and squatter areas is part of the broader dilemma of the poor in developing countries and measures to deal with them are linked to factors affecting poverty as a whole. At the national level, the emphasis on development policy has shifted from maximizing economic growth to increasing the quality of life for the poorest. Emphasis has been placed on rehabilitation, upgrading, renewal and maintenance of existing building stock rather than clearance and relocation (Holdgate, Kassas, White, 1982). An encouraging innovation has been the positive citizen approach towards low income housing through self-help programmes and community development activity encouraged by governments.

The problems and opportunities provided by human settlement differ in magnitude and kind between developing and developed societies.

The developed societies are largely urban and have taken many decades to achieve this degree of urbanization. The current day issues are energy use, the decline of inner city areas and the decrease in urban growth rates. There is a need to revive and rehabilitate cities under strained economic circumstances and a turbulent social environment that exist today.

The UN Conference for Human Settlements held at Vancouver in 1976 and the subsequent establishment of the UN Centre for Human Settlements at Nairobi marked major advances in recognition at the national and international levels of the importance of settlements as part of the human environment. Efforts have been made to enact legislation to enable settlements to offer a 'diversity of contact, humanity of style and neighbourliness all too frequently lacking in the planned city of the past'. (Holdgate, Kassas, White, 1982).

A view which emerged at the Stockholm Conference was that development is a multidimensional concept that encompasses not only the economic and social aspects of a nation but also those related to population, the use of natural resources and the management of the environment to meet basic needs.

It is evident that in many societies, the national food-supply is less than the demand for food. The average daily per capita food intake in developing countries is nearly half that of the developed regions. Between 1974 and 1976, 890 million people in the developing world were undernourished resulting in mental and physical damage, lower productivity of the workers; while malnutrition-related deaths among children under age 5 can be as high as 10 million annually. (Van der Tak, 1979).

In nearly every country, total food production has increased in recent decades but in many parts of Africa, Asia and Latin America, it has not matched population growth. (Mayer, 1976). Drought and floods reduced yields in Africa and Asia. According to FAO, a 60% increase in food, fish and forest production will be needed just to maintain current consumption patterns to the year 2000, let alone increase them.

In the 1980s, mankind faced the pressing need not only to increase food production but also to make the processing, storage and distribution more effective and to improve the security of supply for large numbers of people.

Industry and industrialization together with transport have long been regarded as key elements in development.

Industrial activities are fundamental to living standards in most parts of the world and developing nations have made efforts to achieve fast industrial growth. Industry is not only a source of foreign exchange but is a source of domestic employment and a means of conversion of raw materials into finished products. Its impacts on the environment in the form of pollution and waste disposal has led to the demand for the enforcements of higher standards of environmental quality. Government, industry, international organizations, technical departments in academic institutions and a variety of consumer groups joined in assessing the environmental problems caused by specific industries like the paper and iron and steel industries. This led to the initiation of controls and the adoption of technologies that are more conserving, less polluting, more efficient and generate a better working environment for the worker. The challenge still remains of how to harmonize the industrial and conservation goals in specific areas. (UNIDO, 1979a).

Transport is well recognized as an essential element in socio-economic development. The dominant feature of the world transport scene was the continuing rapid growth in the use of motor vehicles, especially passenger cars. This in turn led to greater energy consumption, pollution, congestion and noise. It even led some governments to support public transport systems. The stress in developing nations has been on rural road programmes and dependable motorized transport.

Transport has four main kinds of impact on the environment. It consumes land for roads, railways, airports and associated facilities. Secondly, resources such as metals, minerals and energy are used in vehicle oil infrastructure construction and operation. Thirdly it generates pollutants which may be discharged to the air or water and may also cause noise and vibration. Finally transport has been responsible for a severe social disbenefit through increased accidents. WHO estimates that a quarter of a million people are killed and several million injured each year in road accidents, many being pedestrians. (UNEP, 1977).

The safe and inexpensive movement of large numbers of people over long distances has been a major determinant of the growth of tourism.

There is a need to plan and manage traffic so as to reduce its adverse environmental and social impacts. Action is currently focused on the efficiency and safety of vehicles, efficient road vehicle management systems such as the use of traffic lights and driver education to ensure the safe uses of transport.

To conclude, people have the means to adapt the environment to their needs unlike plants and animals. The means they use will depend on three factors:

1. Interactions among themselves. These can be characterized by agreement, disagreement, war and peace, justice and injustice.

2. Interactions with the biophysical environment.

3. The social-cultural attributes of a society such as intellect, emotions, beliefs and traditions.

These interactions and the resultant human activities will therefore exert an influence on the environment and result in changes. Hence, the challenge lies in the ability of societies to design ways of adjusting to this change to promote their well being without destroying their environment. It is in the cultivation of suitable attitudes and values that enhance 'Development without Destruction' that social science teachers and supervisors can have the greatest impact.

Chapter 3

ESSENTIAL KNOWLEDGE FOR SECONDARY SCHOOL SOCIAL SCIENCE TEACHERS AND SUPERVISORS ABOUT THE PROBLEMS OF THE ENVIRONMENT AND MEANS AND WAYS FOR THEIR SOLUTION AND PREVENTION

Introduction

This chapter describes the main problems of the environment with reference to actual examples and suggests approaches to their control, prevention and possible solution. Such background information adds to the knowledge component which the social science teacher and supervisor can use to promote the attitudes and values in making decisions that contribute to the improvement and protection of the environment of which we are an important part and in which society functions.

The basic issue underlying all the various environmental problems is a question of VALUES and ATTITUDES. EE is not just concerned with the application of science and technology to the solution of problems but fundamentally it is concerned with the kind of people we are, the attitudes and values we hold and what we do to improve the environment, we and subsequent generations are to live in. SOCIAL ACTION is important as is highlighted by Aristotle:

> 'The ultimate end ... is not knowledge, but ACTION. To be half right on time may be more important than to obtain the whole truth too late.'

Human activities take place within the environment. Refer to diagram 10. People are affected by that environment in everything they do. They, in turn, manipulate that environment to sustain them and their lifestyles. The natural resources of air, water, soil, minerals, plants and animals provide their needs for food, shelter, clothing, education, recreation and job opportunities. The technology their social cultural systems have devised and which is constantly advancing with scientific progress, increases their ability to exploit the environment turning the natural ecosystems into modified ecosystems as shown in diagram 10.

During the process of modification, problems arise, for example, soil deterioration. Modified ecosystems need to be managed and the type of management selected may intensify existing problems or cause new ones. For example, the incidence of water borne diseases such as bilharzia and dysentery increase due to irrigation projects. Ecosystems could be modified so that the recycling process of materials (ecology processes) is upset and nothing goes back to enhance or rebuild the natural resources. Examples include the natural soil building processes, the ability of water to purify itself and the ability of forests to sustain themselves.

Environmental problems are intensified by the fact that the human population is rapidly increasing as discussed in the previous chapter. Increased population means increased demand for goods and services and this indicates greater use of and pressure on the non-renewable resources.

Food production also increases the rate of production of other raw materials and energy increases as a response to increased production of goods. Energy use also rises. Pollution produced during the production of goods, food and energy increase proportionally in quantity and quality. When discharged on the land, soil or water these wastes overload the natural systems such that their capacity to assimilate them is reduced. This can lead to disease, discomfort and ecological imbalance.

More and more land is taken up by people to build on (rapid urbanization and its associated social cultural problems), to produce goods (rapid industrialization), to excavate for minerals and energy sources and to dump wastes on. As environmental pollution increases, there must be an element of payment and this is also on the increase. Countries must pay to control and manage environmental problems, especially pollution, either in the form of preventive or corrective measures.

Classification of environmental problems

At the Tbilisi Conference, the types of environmental problems were classified from several points of view:

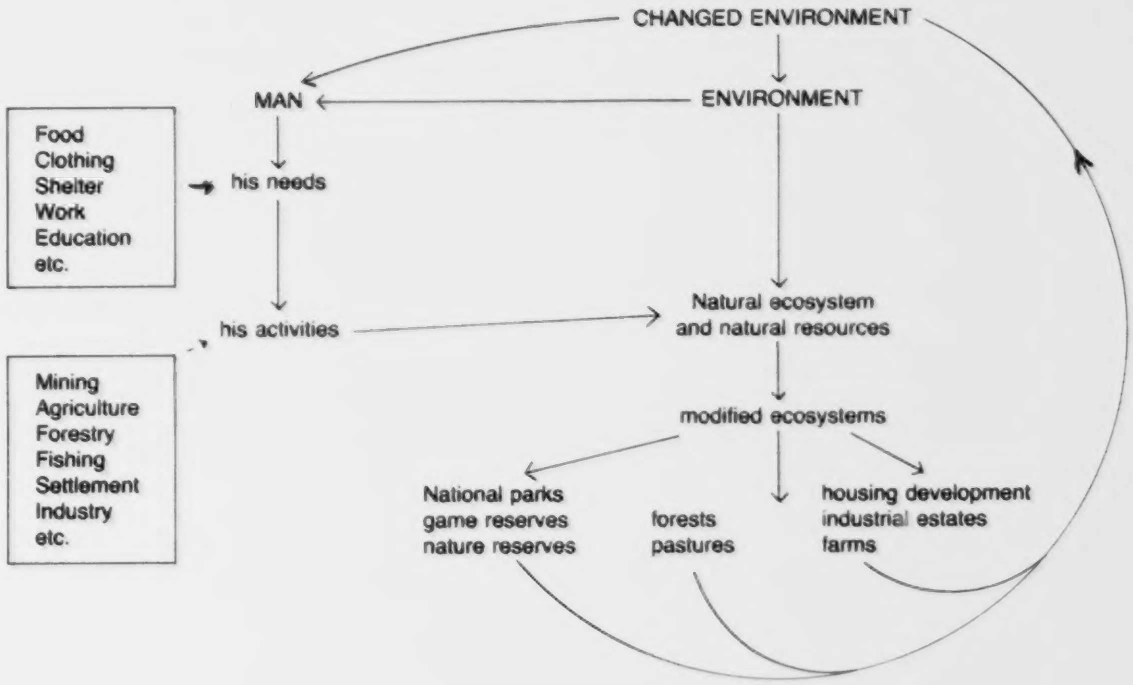
1. Physical, Economic and Social Consequences

2. Geographical Scale

3. Time-Scale

4. Social, Economic System

Diagram 10: Bridging Man and the Environment



MAN'S RELATIONSHIP WITH THE ENVIRONMENT

We shall consider each of this set of problems, their cause and consequences separately. Finally, we shall consider their collective preventive and control measures. It is relevant to note here that the problems are basically the same but looked at from different viewpoints. Hence, greater stress is given to the first group.

PHYSICAL, ECONOMIC AND SOCIAL CONSEQUENCES

Under this group are problems that reduce the quality and quantity of a resource, cause chemical and biological pollution and physical disruption resulting in a reduced quality of life in terms of physical, economic and social repercussions.

Each set of problems shall be briefly discussed.

(1) Qualitative and Quantitative Resource Deterioration

Soil Loss

Soil has been defined as the topmost layer of the earth's crust. It is a component of the biosphere and on it interact living organisms, their energy, the product of their metabolism and death. It is a result of interaction of living matter and weathered rock. It is soil that supports the plant life which is solely responsible for converting sunlight into chemical energy which is then passed through the ecosystem. Soil, plant and water form the life support systems of the world and without which no society can survive.

Yet, the fact remains that global soil resources are very limited both in quantity and quality. Only about 30% of all the available land is ideal and FAO claims that only 32 million square kilometers of available land is potentially good for farming and the best of this is already cultivated.

Soil loss is a natural process called erosion. It has taken place since the earth came into being. However, the process is as slow as is the process of soil formation. It is when human activities accelerate soil loss that problems arise. According to UNEP there are many kinds of dangers that threaten soil causing loss of both quality and quantity.

Soil is lost through erosion by wind and/or water resulting in physical removal of earth. This is often a result of soil exposure to these elements through human activities such as removal of vegetation, fire, overcultivation and overgrazing. Soil is also physically lost as a result of widespread mining activities, building, transport and communications. In some areas good soils are covered by unproductive silt carried by water or wind. Soil properties could be disastrously changed resulting in impoverished soils.

Examples include overcultivation in poor rural areas of developing countries where the same kind of food is grown year after year. This deprives the soil of certain essential minerals and food yields decline year after year. When this occurs in a year of low rainfall, the result is disastrous both economically and politically. Hunger and famine then afflict many societies in the developing world.

In marginal lands, like the Sahel in Africa, wells have been drilled and water pumped for domestic and industrial use. This alters the water balance and often results in increased frequency of droughts, crop failure and loss of natural vegetation. The end result is a drop in the humus content of soil. This is of concern as it is humus which gives soil its water retention capacity.

Humus content can also be reduced when farmers overuse inorganic fertilizers and fail to return plant residue back to the soil. In some countries of Africa uninformed farmers sell their plant residue to other farmers who own cows or use it for plastering houses.

Irrigated areas and areas with poor drainage have soils that are prone to waterlogging and flooding. This could result in a dangerous change in the water balance where the percolation rate is reduced. The water table is not replenished while evaporation increases.

Soil compaction is another form of soil impoverishment. Soil with good structure changes into a massive, heavy, compact, swelling rock which, when dry, is broken into blocks by large rocks and when wet, it is impermeable to air or water. Compacted soils are common in the savannah, steppe and on plains which have been overgrazed, irrigated with alkaline water or are naturally badly drained.

Soil is both physically lost and degraded when a piece of land is turned into a waste strip. This is necessitated by the increased production of non-biodegradable solid wastes and lack of a recycling process for them. Solid wastes are those that are not directly released into the air or water for disposal.

Soil is also degraded by accumulation of chemical pollutants and toxic materials from industrial wastes. These include gasses, metal works, automobile exhausts, sulphuric waste from mines, waste products from soil fields and dust from cement factories. Unbalanced and uncontrolled use of fertilizers, herbicides, pesticides and detergents pollute the soil with chemicals.

At times, the physical features of soils are changed by improper use in relation to its potentialities. This is, in many cases, due to ignorance, poverty or sheer greed. For example, the resettlement process in formerly colonized countries has led people to settle in agricultural marginal land to ease population pressure on high potential land. These people have imported their agricultural systems including crops of high potential to low potential areas where the land is only suited for grazing and has been ecologically maintained as such by nomads with their cultural habit of seasonal migrations. After a few years, the land becomes dry and unproductive, soils are exposed to weather elements, humus is lost and compaction takes place.

Another example is where uncontrolled economic activities such as deforestation has resulted in petrification. This is a process by which organic materials are replaced by inorganic matter dissolved in water turning the soil into a useless stony substance. It is a common process in humid tropical lands.

Much attention has been given to the environmental problems of soil loss. The soil is the basis of prosperity of any society and hence we should recognize the importance of conserving this valuable natural resource and act with a sense of urgency to reserve the process before it is too late. History has many examples of civilizations destroyed when the basis of their sustenance, the soil, was made unproductive through human neglect and/or activities.

Many societies are currently conscious of the seriousness of the problem and efforts to conserve the soil such as tree-planting, building of terraces, crops rotation, are vigorously pursued.

Devegetation

This is the removal of vegetation - grasses, bushes, and trees - such that the soil is left bare. Devegetation is caused by one or more of the following:

(i) Population increase and its demand for more land for urban development including the construction of roads and airstrips, land for agriculture to grow both food and cash crops like tea and coffee in East Africa, and rubber in Malaysia are replacing large tracks of forest.

(ii) Large scale logging as in many developed and developing nations to cater for the rising demands of timber, pulp and paper and other forest products.

(iii) The replacement of indigenous hardwood trees in tropical forests by fast growing, economically more viable softwoods such as pines and firs.

(iv) The conversion of grasslands to ranches.

(v) Overgrazing particularly around sources of water.

(vi) Fires: some farmers set grasslands on fire before the rains in the hope of getting a better crop of grains. Other forest fires are caused through human carelessness.

Destruction of vegetation results in simplification of the ecosystem structure through elimination of plants which play a vital role in the ecological food chain. This makes the ecosystem vulnerable. Not only plants but animal species too are reduced as their habitat is destroyed. Once the vegetation such as forests are destroyed, insect vectors may increase and become a health hazard. For example, the tse-tse fly increases in the bush that takes over from forests and increases the incidence of sleeping sickness among people and their animals. This then has economic and social implications.

Vegetation, especially forest, enhance the atmosphere by absorbing carbon dioxide and giving out oxygen, making the climate cooler and increasing the incidence of rainfall. Watershed forests hold the soil, regulate river flow and replenish ground water. Removal upsets the water balance resulting in frequent flood and loss of life and property as has occurred in the lower foothills of the Himalayas. It accelerates soil erosion resulting in silting of reservoirs and interfering with economic activities like hydro-electric production, irrigation and transport. Devegetation destroys marine habitats as the coral reefs along the Kenya coast and in other areas such as the seaside resorts of the U.K. silt has been deposited along shores obstructing recreational facilities. This then entails greater expenditure in maintaining these social facilities.

Among the poorest in the world, devegetation results in the removal of the only source of fuel, water and constructional materials. Once these are not available, people's lives tend to be disrupted and migration to the urban areas take place with its attendant social, economic, cultural and religious implications. Such groups constitute the 'urban poor' and concentrate in slums with their lack of facilities and associated hardships and often lose their identity and can pose a social threat to the community of that area. Furthermore, the cost of reconstruction is too high for many nations to afford.

Some solutions

Both governmental and non-governmental efforts have been directed to the solution of this problem by raising the level of awareness and concern of all people on this problem and secondly by actively encouraging re-afforestation and afforestation programmes. In rural areas, people are encouraged to plant trees, shrubs and other vegetation cover on their land. This mode of action provides soil cover, constructional materials and fuel. Other good conservation practices include re-afforestation in forest lands and control of consumption by recycling to reduce waste. Examples include the recycling of waste paper in the production of tissue paper; the use of sawdust for poultry and as a soil conditioner; the use of steel in production of cooking stoves or 'jikos'.

Other measures include the improvement of fire fighting and fire tracing facilities, the training of forest managers and research work and the active role of teachers and supervisors in the promotion of conservation education at all levels.

Local self-help groups at the grassroot level such as the National Council of Women in Kenya, and the Chipko movement in India have been very effective in this direction.

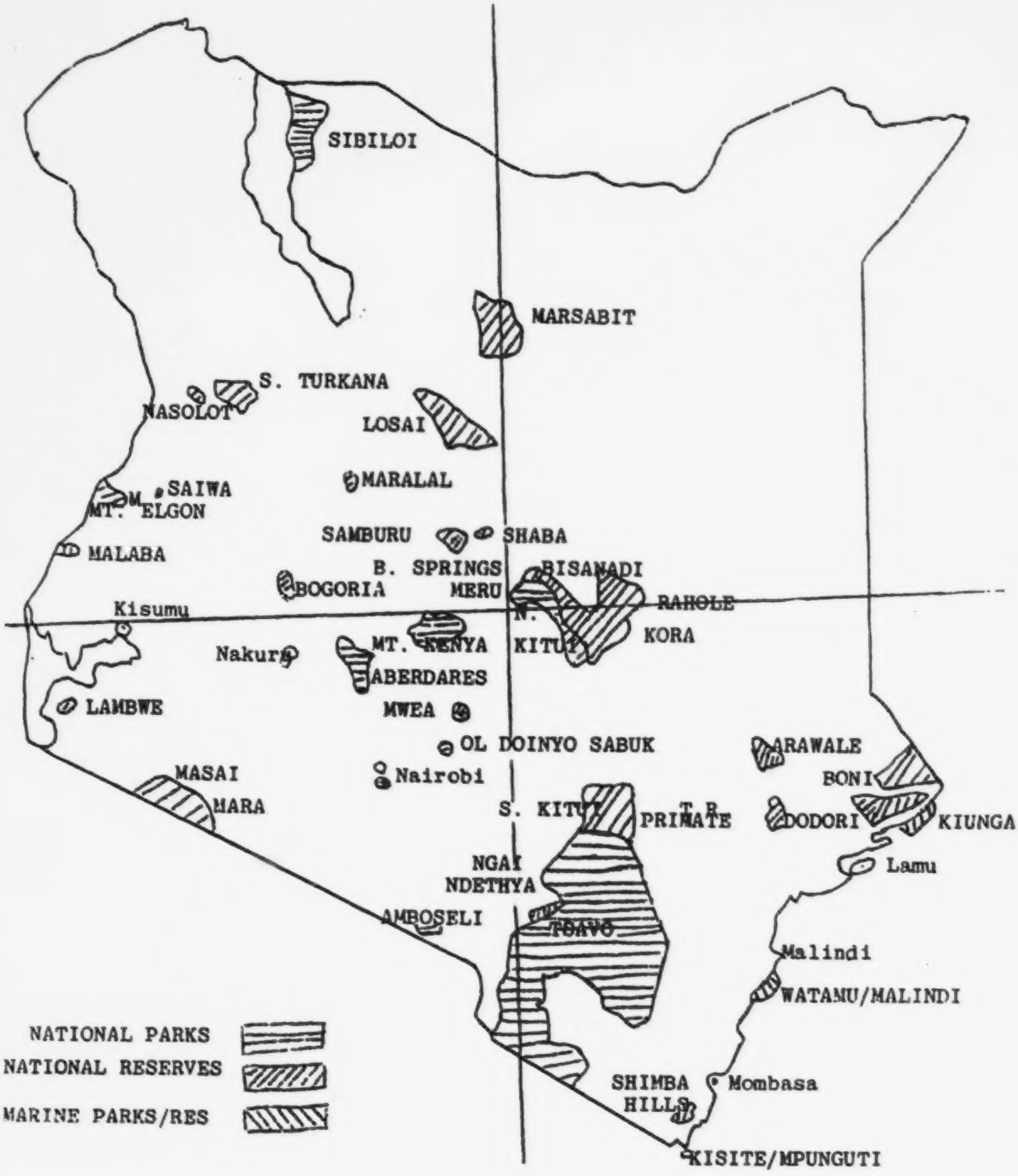
The International Council for Research in Agro-forestry (ICRAF) set up in Nairobi, Kenya in 1979 is doing research and trying to promote techniques of agro-forestry. This technique meets immediate nutritional needs, earns cash, restores and promotes the environment. It may be the answer to developing countries with limited land and dependent on agriculture.

Impoverishment of Wildlife

Human activities have reduced not only the soil and vegetation but animal life in the wilderness. There are extinct and endangered species in the world. Extinct species as outlined by the IUCN Red Data Book include the dodo and passenger pigeon. Extinction has the effect of reducing diversity in the ecosystem and hence truncating lines of evolution.

In many countries there is a conflict between the needs of the local people and those of the animals. This leads to destruction of wildlife habitat for settlements, farming, forestry, pasture, woods and industries. Wildlife get pushed into protected areas such as national parks and game reserves where the boundaries are not ecologically viable. Refer to Map IV illustrating the protected areas in Kenya. Some are too small and ignore the migratory habits of animals. When food is scarce, animals migrate into settled areas and attack or are attacked by people. In a case like in the world famous Tsavo National Park in Kenya, elephants have destroyed the trees ruining their habitat and that of other browsers. The caribou in Canada is also known to have destroyed its habitat due to concentration and protection. Wastes like heat, solids, chemicals from industries, domestic, agricultural and mining wastes degrade aquatic habitats as does water extraction, flooding and silting. Over the years animals have been reduced by capturing them in large numbers for food, fashion, research and sport. Poaching, which is present in many countries, takes no consideration of the age or sex of the animal. It allows no rest period thus reducing the breeding potential of the species. In Kenya, alone, all the large animals like the grevy zebra, the sable antelope, the roan, the hippo, the lion and the leopard are endangered. The rhino has been reduced from 8,800 in 1969 to 81 in 1980 due to hunting and poaching.

Introduction of exotic species which compete for food and space reduce the wildlife. Some over populate and colonize the habitat due to lack of predators. Examples are as follows: Salvinia molesta a native plant of South America mysteriously introduced in some African lakes like Lake Naivasha in Kenya and the Kariba Dam in Zambia have threatened to turn the lakes into swamps by forming a vast floating mat on the surface obstructing all activities and suffocating fish and submerged plants. As a result of this, people have suffered due to the loss of income and food resulting from a decline in fishing activity.

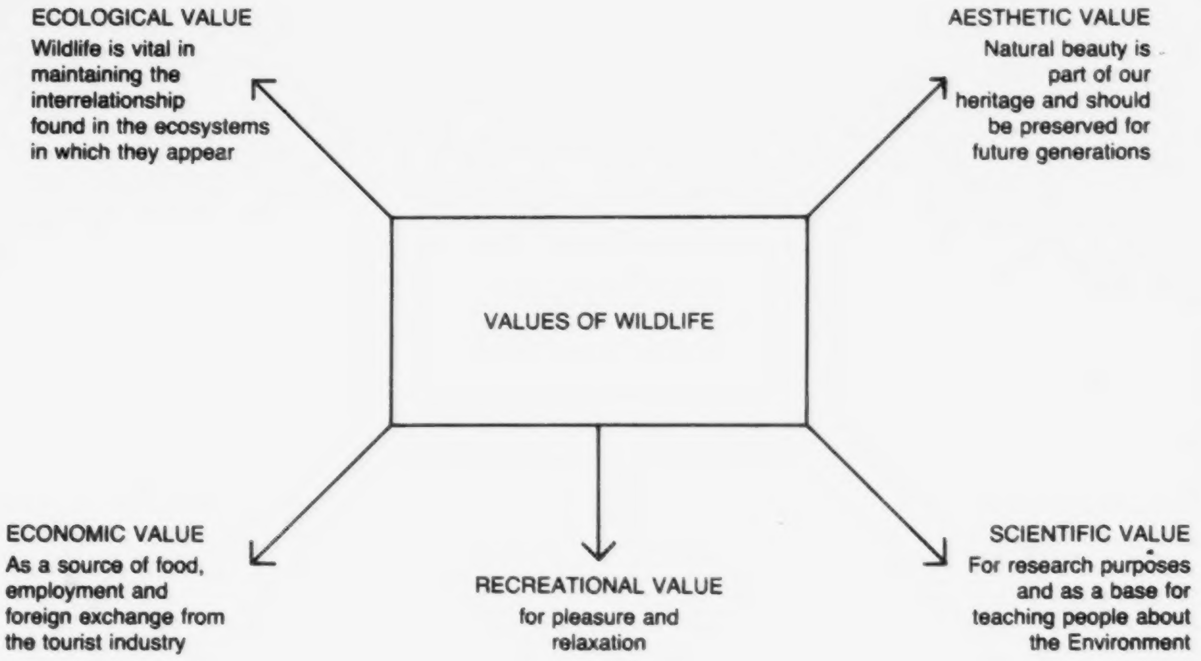


MAP IV KENYA NATIONAL PARKS AND RESERVES

Introduced trout and bass in the USA and tilapia in East African lakes have threatened many indigenous species of fish. Diseases are easily transmitted from exotic species to wildlife. This happens where people and wildlife co-exist as in the drier parts of East Africa. In such areas the habitat is also destroyed by overgrazing by domestic animals.

Deterioration of wildlife means reduction in what it has to offer. Refer to diagram 11.

Diagram 11: Values of Wildlife



VALUES OF WILDLIFE

ECOLOGICAL VALUE
Wildlife is vital in maintaining the interrelationship found in the ecosystems in which they appear

AESTHETIC VALUE
Natural beauty is part of our heritage and should be preserved for future generations

ECONOMIC VALUE
As a source of food, employment and foreign exchange from the tourist industry

RECREATIONAL VALUE
for pleasure and relaxation

SCIENTIFIC VALUE
For research purposes and as a base for teaching people about the Environment

Some solutions

Deterioration of this resource could be stopped through proper planning and management, maintenance of habitat, maintenance of breeding stock by organized game cropping, research and training of rangers and technical staff and the improvement of anti-poaching units.

Conservation education is vital. It is in this sphere that the social science teacher and supervisor can through their respective subject areas encourage the formation of positive attitudes and values towards wildlife which both in class and out of class activities such as wildlife clubs to raise the level of awareness and commitment that no one will kill an animal without a constructive reason.

Reduction of Water Quality

Good quality water is relevant to the use for which the water is meant be it domestic, trade, agriculture, recreation or as habitat for aquatic organisms. Water quality can be reduced by the presence of organic wastes such as effluent from sewage treatment plants, industrial plants like pulp and paper mills, food processing plants, petroleum refineries and tanneries. Organic wastes increase the biological oxygen demand by providing food for bacteria which increase rapidly. While decomposing, organic wastes take up oxygen and could cause fish to suffocate. Untreated sewage can contain disease organisms which could then turn water into a 'killer' and a public health problem. It could carry disease germs causing cholera, bilharzia, dysentery and others. Oil, especially in coastal areas caused by accidents with tankers, spills from refineries, underground seepage and offshore drilling clogs, fish gills and prevents birds from flying to look for food. When taken in, it affects vital organs like the liver and kidneys.

Water quality is also reduced by the presence of suspended solids from agricultural land due to poor land management and floods, and from non-biodegradable industrial and municipal waters. They obstruct light from reaching the submerged plants for photosynthesis. When they settle, they destroy spawning grounds for fish, foul beaches and ruin the tourist trade.

Plant nutrients like phosphates from detergents and sewage plants cause eutrophication of water bodies. Water with suspended solids look too dirty to drink. Some of the chemicals contained in liquid wastes are toxic to aquatic life such as mercury from industrial plants. Wastes from power generation plants alter the heat balance in an aquatic habitat. Reduction of water by extraction means that water left in a river or lake is more easily polluted.

Some solutions

Water in adequate quality and quantity is a must for all people to meet their social, economic and cultural needs. No individual or society can survive for long without this vital resource. Hence the need to exert all efforts to retain the quality of water we have.

Water quality can be maintained by avoiding dumping solid wastes in water and either recycling them or disposing of them in a sanitary landfill. Domestic water should be treated before use while liquid wastes should also be treated before disposal into rivers or lakes. Good land management should reduce soil erosion while national emission standards for all industries should be set and maintained. Many times water quality maintenance requires punishment of offenders to deter them. Water conservation measures at the individual level are essential. For many of the problems described above are the result of deliberate and conscious human behaviour and this is an area where the social science teacher and supervisor could assist by encouraging responsible behaviour in the use of water.

Reduction of Atmospheric Quality

Air is an invisible odourless mixture of gases, the main ones being oxygen, needed by plants and animals, carbon dioxide necessary for photosynthesis by green plants and nitrogen which is essential in the soil as food for green plants. Air exists as a thin layer surrounding the earth which cannot be expected to assimilate man-made pollutants for ever.

Air pollution has been described as the addition to the atmosphere of pollutants in quantities which are not only harmful and injurious to life but also those that interfere with comfort or property. These pollutants lower the quality of the resource. These could be heat, aerosols, smoke fumes, gases, vapours, oxides, hydrocarbons and particles. The major sources of these are vehicles, industries, space heating, refuse and agricultural burning.

Polluted air is of great public concern because it interferes with visibility, it is a nuisance, causing odours, dirt and economic loss. Most of all its danger is in creating public health problems. Some of these are explained in diagram 12. When fog combines with smoke and fumes from vehicles and factories, the resulting smoke is a killer. Temperature inversion too prevents pollutants from being dispersed and causes them to be concentrated where people are, causing death of the very young and old as well as those with heart and respiratory problems.

Inhaled pollutants also affect animals. Phosphate mines give out fluorides that settle on grass and later are ingested by animals causing fluorosis. Presence of particulate matter in the atmosphere could reduce sunlight reaching green plants and retard their growth, while once it settles on plants it closes the stomata and prevents transpiration. Increased carbon dioxide in the atmosphere can increase the rate of photosynthesis and favour some plants thus upsetting the ecological balance. Corrosive chemicals like sulphur dioxide combine with water to produce acids which break down plant tissue. This is of concern to all people as plants are our main source of food and fibre, so great care must be taken in the management of human activities to minimize air pollution.

Some solutions

A modification of human activities combined with efforts in technological innovations should be a step towards preventing air quality from being reduced. Examples include the modification of engines to permit more combustion of fuel to reduce polluting fumes; the development of non-polluting motors such as steam engines and motor cars; the development of devices such as smoke sticks to collect dust, soot and fly ash before they get into the air because it is rather difficult to clean polluted air; the recycling of pollutants while nations should pass clean air acts and ensure effectiveness, individuals working with pollutants ought to protect themselves by using masks.

Exhaustion of Minerals and Fossil Fuels

Minerals form a major source of the raw materials for industrial activity while fuel is the power source that facilitates the industrial process. Without these, industrial development would not take place in a country unless expensive measures to acquire them from elsewhere are undertaken. Unfortunately minerals and fossil fuels are exhaustible resources. Over use and misuse due to actual need, carelessness, greed or maintenance of an affluent life style are prevalent in the world today. Once the minerals and fossil fuels are scarce, societies will be disrupted in their economic, political and social set-up.

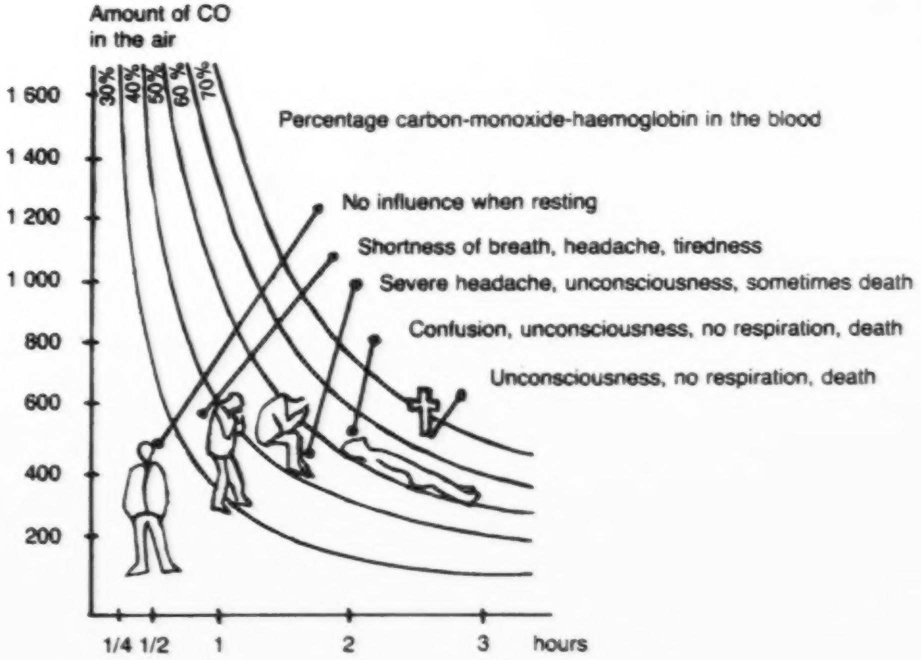
Some solutions

These can be found in conservation measures coupled with development and adoption of new and renewable energy sources like wind, water, biogas and wood. Resistance to adoption of new sources of energy and other materials can be overcome by EE.

(2) Environmental Diseases

These are of concern to all people as they pose public health and socio-economic problems. It touches all spheres of life be they political, social, economic, cultural, religious and are found within certain areas of the world because of the nature of the prevailing climatic conditions. These include malaria, bilharzia, river blindness, cholera, intestinal worms and others. Where they occur, mainly in the poor countries these diseases take up over 80% of hospital beds. The incidence

Diagram 12: Some effects of air pollution on the human body

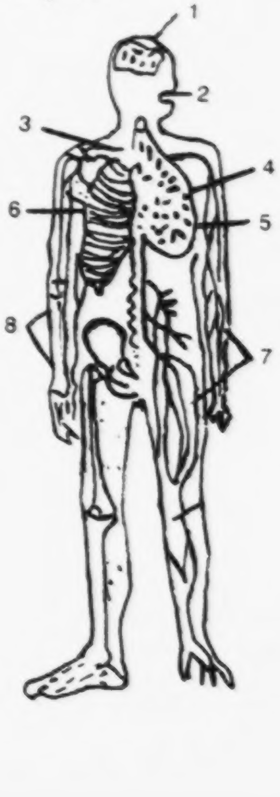


The influence of carbonmonoxide (CO) on the human body

Carbonmonoxide blocks the uptaking of oxygen in the lungs. Instead of oxygen, the haemoglobin takes up CO in the lungs and a stable compound called carbon-monoxi-haemoglobin is formed. (ppm = parts per million).

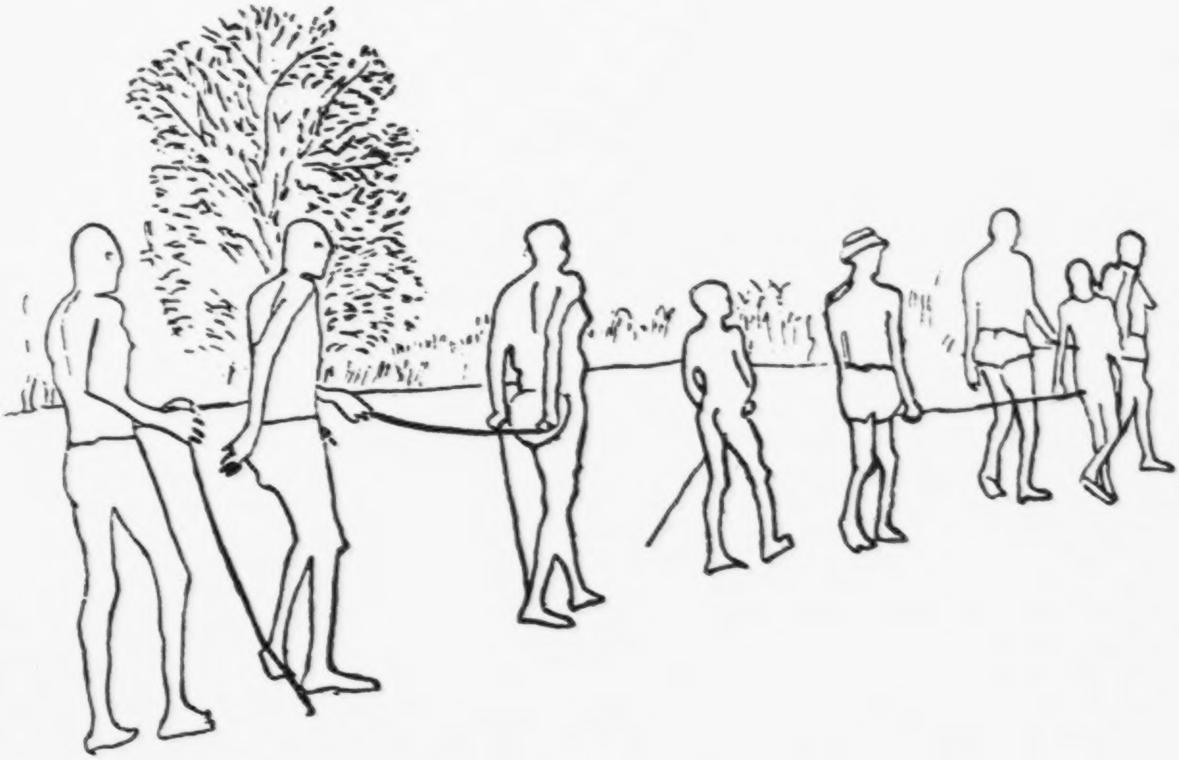
AIR-POLLUTIONS AND HUMAN BODY

Number	Part of the body	Damaging substance
1.	Brain	Lead
2.	Teeth	Flourine
3.	Mucous Membraines of e.g. trachea	
4.	Heart	
5.	Lungs	
6.	Skeleton	
7.	Blood	



of re-infection once patients go home is high as most of these diseases are associated with contaminated water. The occurrence of these diseases in poor countries is increased by development projects such as irrigation schemes, dams for H.E.P. and water kiosks. While some of the diseases are killer diseases like malaria and cholera, others like bilharzia and river blindness are debilitating and reduce people's productivity. The effects of the latter disease are most marked in the Upper Volta where males are most affected. This means that the economic burden falls on women and children causing great distortions in their lives. Such socio-economic effects are not without their political repercussions. Hence the challenge to control or even eradicate some of these environmental health hazards in developing nations. Refer to diagram 13.

Diagram 13: ONCHOCERCIASIS (RIVER BLINDNESS)



Onchocerciasis is a filarial disease producing ocular disturbances often leading to blindness and hence reduced productivity. (Adapted from WHO photo distributed by UNEP . UNEP - 0279.)

Some solutions

To eradicate these diseases, an understanding of the life cycles of organisms that cause them is required.

Bilharzia or Schistosomiasis: this disease affects almost 200 million people in the world. Rice growing and fish farming are the occupations with the highest risk. The disease is caused by few species of blood flukes or schistosoma but the most common ones are as follows:

(i) Schistosoma haematobium: common in the Eastern Mediterreanean and most of Africa.

(ii) Schistosoma mansoni: common in the Eastern Mediterranean, Africa, parts of Central and South America.

(iii) Schistosoma japonicum: common in Eastern Asia.

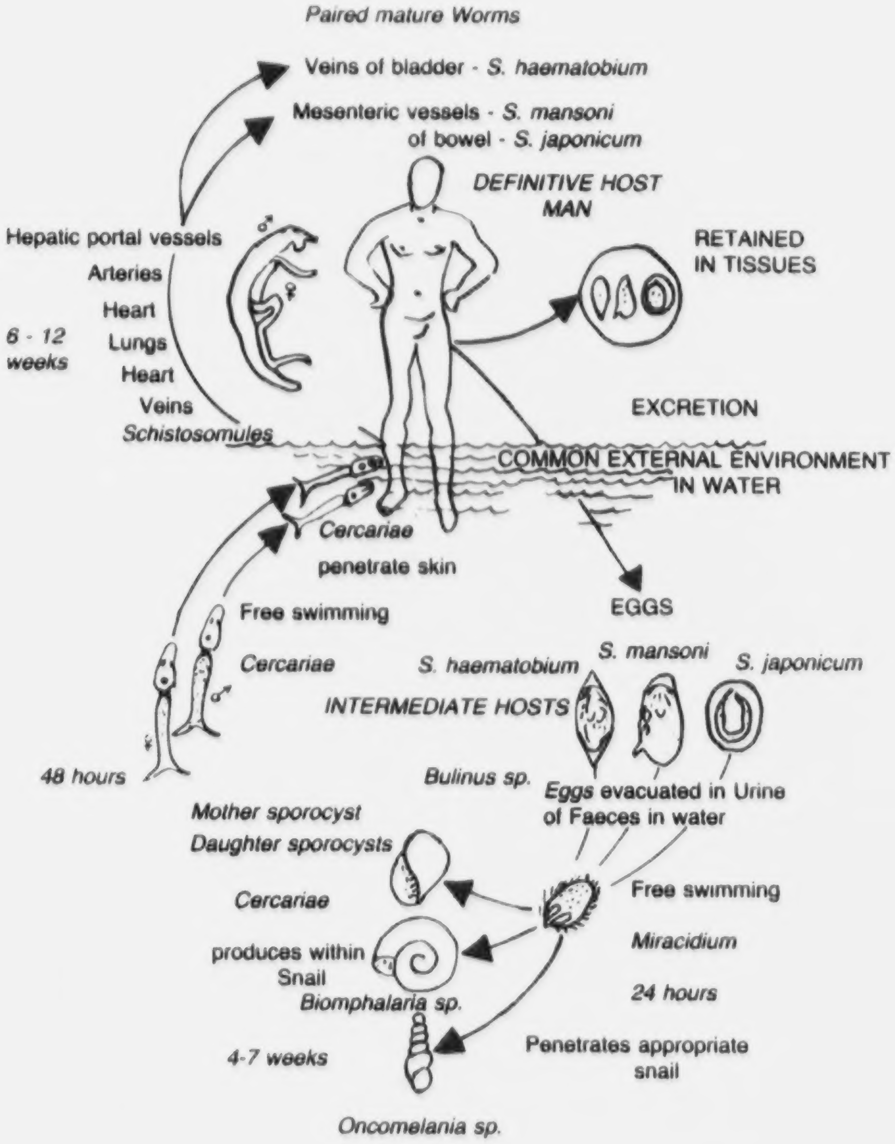
Diagram 14 illustrates the life cycle effects of bilharzia. The control methods must interrupt the life cycle. For example: the reduction of contamination of water by human excreta. This can be achieved through educating people on proper disposal of human wastes, providing clean treated water supply and proper drainage for that water. Problems arise because of traditions and cultural taboos in many areas where the disease is found, do not allow the use of toilets and pit latrines. Such attitudes can be changed through education indicating the role the teacher and supervisor can exercise when promoting EE.

Attempts have been made to eliminate the intermediate host the snail by destroying their habitat, regularly flushing irrigation canals, removing reeds, physically removing the snails or poisoning them with molluscicides such as copper sulphate. However, science has not yet developed a molluscicide that does not affect non-target organisms like fish. The next best thing is to treat the infected persons with drugs like Vansil. The latter have proved to have drastic side-effects and cases of re-infection are high. Hence, no single method is completely effective. The most successful approach is an integration of all the above methods combined with educating the masses so as to get their good will and popular participation.

Malaria: this is a disease of the tropical lands which affects over ten million people a year. It is caused by a parasite which is transmitted by the bite of an infected female anophene mosquito. Its general symptoms are chills, fever, and sweating occurring at intervals of 48 to 72 hours, when toxins are released from the parasite as the red cells burst.

In 1955, WHO started a global malaria eradication strategy which involved destroying mosquito habitat by draining stagnant water altering the water, salinity and exposure to sunlight, use of drugs like quinine to kill parasites in humans and extensive use of DDT after its invention in 1942. At first, the strategy was successful but more recently malaria has staged a resurgence. This is due to various factors: many countries are known to have relaxed the campaign after political independence due to expenses and lack of commitment; malaria parasites and vectors have developed resistance to drugs and pesticides while the adverse side effects of DDT on the human environment have been realized and have discouraged its use. Like in the case of bilharzia, there are several ways of eradicating malaria through habitat management. These include the modification of aquatic habitat to destroy the breeding ground for mosquitoes; the use of biological control, that is, the use of species like fish (Gambusia affinis) to eat mosquito larvae; the application of the sterile male technique where sterile males are produced in the laboratory and released to mate with the females in the field; the efforts made to produce an anti-malaria vaccine.

Diagram 14: Life-Cycle of Schistosomes



(UNEP - 0304 After Jordan and Webbe 1969)

To succeed in the anti-malaria campaign, both chemical and ecological measures should be used in an integrated manner rather than relying on a single technique. These must be fully supported by community participation and education as well as correct land and water management.

(3) Chemical Pollution

A chemical pollutant or poison is any substance that chemically reacts on the physiological functioning of a living organism and by so doing kills, injures or impairs the organism. As described in the section on air pollution, some chemicals corrode inanimate matter. Due to the interrelatedness and interdependence of organisms within an ecosystem, chemical pollutants can have far reaching effects in the environment through their accumulation in the food chain some of the chemicals are highly toxic and their effect is immediate. Others have a slow reaction as they accumulate in organisms and their effects could be carcinogenic or mutagenic. So far there are about 30,000 different chemicals being commercially produced.

Instances of possible poisoning in both developed and developing countries are high due to the interrelatedness of pathways of these chemicals and the fact that they are increasingly found in goods that people have daily contact on their person, at home and in the fields.

NOTE: People are the top predators on planet earth. Any chemical that concentrates in the food-chain represents a particular hazard to them.

Diagram 15:

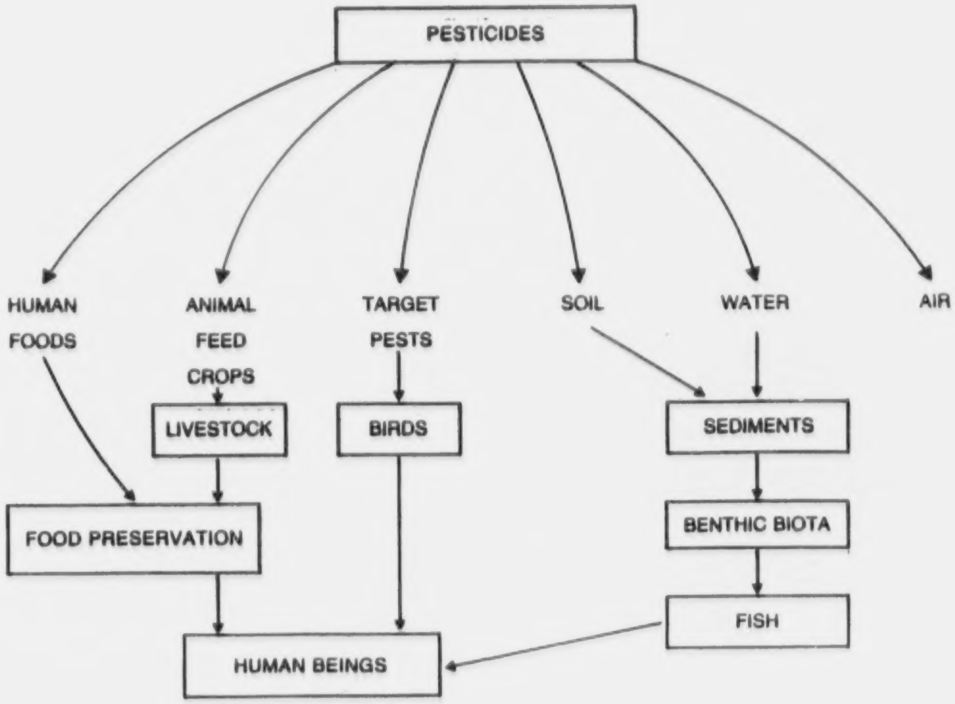


Diagram 15 illustrates some pesticide pathways in an environment. Others include the direct application of fertilizer, drugs; combustion process in industries, home, vehicles; waste products of the manufacturing process in factories, transport and consumption of goods.

Chemicals could be one of the following:

(i) Drugs: these are used in treatment of disease but cause unwanted side effects. A good example is 'thalidomide' used for treating morning sickness in expectant mothers in the early 1960's but which caused birth defects.

(ii) Antibiotics: many of these contain sulphur and can have effects ranging from mild rashes to death of users depending on the individual level of tolerance. If wrong doses, especially underdoses, are taken, resistant strains are developed which become resistant to the antibiotic. At times, mass elimination of a type of bacteria creates conditions ideal to the growth of another more infectious one.

(iii) Cosmetics: many lightening creams like 'Ambi' contain mercury which could poison the nervous system and cause kidney disease.

(iv) Stimulants and tranquillizers, when abused, cause addiction with serious depressions when misused.

(v) Biocides: these are chemicals used to kill pests mainly to increase food production and fight disease like malaria. They include insecticides, fungicides, herbicides, molluscicides and pesticides. The most studied of these is DDT (dichloro - diphenyl - trichloro-ethane) which has been sprayed in the environment since the Second World War. It is now banned in the developed countries and in certain developing countries.

Research has shown that chemicals like DDT are very dangerous because of their characteristics. They are stable and are very slowly destroyed by natural processes in the environment. They are fat soluble and therefore accumulate in the fatty tissue of most animals. They accumulate in the food-chain with the larger animals including man magnifying the concentrations. They are highly mobile and have been found in distilled water, evaporated with water vapour, found in Antarctic penguins, in mothers' milk and the unborn foetus.

The effects of DDT have been found to diminish populations of birds by causing birds to lay eggs with weak shells that do not survive the pressure during incubation. In people, DDT has been found to affect the liver. Instances of pesticide impact on human health are many but a few have reached epidemic nature. Examples include the Karemi Yusho disease in Japan which in 1968 affected hundreds of people, who ate Karemi rice oil contaminated with chemicals. In Italy in 1976 many died due to exposure to another chemical, dioxin, released in a chemical explosion.

(vi) Fertilizers: these involve the use of inorganic nitrates and phosphates to increase food yields. Yet when they get washed into rivers and lakes they cause an enrichment of the waters leading to explosive blooms of vegetation which disrupt the normal functioning in the ecosystem as is borne out by the Lake Erie case. Overuse of inorganic fertilizers deprive the soil of humus essential for soil and plants.

(vii) Food Additives: these occur in the form of colouring and preservatives. They could trigger reactions favourable to cancer in different people.

(viii) Metals: trace metals are now found everywhere in the environment. Some heavy metals like cadmium and mercury are toxic while others like zinc and copper should not be taken in excess. When toxic metals react with organic compounds deadly compounds can be produced. This reaction can be brought about by micro-organisms in the process of protecting themselves from the toxic effects of metals that have been dumped in the habitat. For example, in 1960 mercury wastes from a fertilizer plant were dumped in Minamatas Bay, Japan. Fish then imbibed the mercury from the water and all those who ate the fish suffered from a deadly nerve poisoning. Japan has also had large scale cadmium poisoning referred to as Itai Itai disease caused by wastes from a zinc smelter. The link between environmental causes to socio-economic effects are made evident from such examples.

(ix) Liquid Wastes: these refer to the chemicals contained in waste waters from industries, homes and sewage treatment plants.

Some solutions

As a result of human activities, such as industrialization and affluent life-style, particularly in the developed world chemical pollution exists and has to be controlled and/or prevented at both national and personal levels. Nations should set up tolerance levels as well as standards followed by legislation to ensure standards are maintained, the environment protected and the health of the people safeguarded.

People should be educated on the harmful effects of chemicals so that they can make proper choices. For example, choose lethal but less persistent pesticides (pyrethrum instead of DDT), learn to use inorganic fertilizers with organic manure and take medicine with care and antibiotics only with a doctor's prescription. Efforts should be made to re-use some of the chemical by-products of the manufacturing process, improve storage to avoid leakage, and continue research work to find out more about the effects of drugs on the ecosystem.

(4) Physical Disruption

This set of problems arise from human activities and include noise pollution, heat pollution, silting of waters and aesthetic pollution.

Noise pollution has been defined as sound which comes from human activities in amounts or qualities that harm humans as well as interfere with their enjoyment of their property. Noise is found everywhere and seems to increase with advances in technology. Though it comes and goes, its effects remain. Refer to diagram 16 for the major sources of noise pollution.

Studies have shown that noise can cause pain, produce permanent hearing loss and even affect mental health. It can also interfere with sleep and cause annoyance. Noise can also cause cracks on walls, and breakages of windows. Aircraft noise, expecially from the Jumbo Jet has been known to cause some pregnant women to abort.

Noise is a pollutant that requires a lot of personal commitment to control. Planning is necessary, for example building roads that keep noise out of residential areas, hospitals and schools, using noise arresting materials in buildings; legislation to control noise levels and the use of technology to invent ways and means of reducing noise. Every person exposed to high noise levels should be aware enough to ensure personal ear protection by using ear muffs and to voice concern.

Thermal pollution as produced during power production can disrupt the natural habitat of aquatic organisms by raising the water temperature.

Diagram 16: Major Sources of Noise

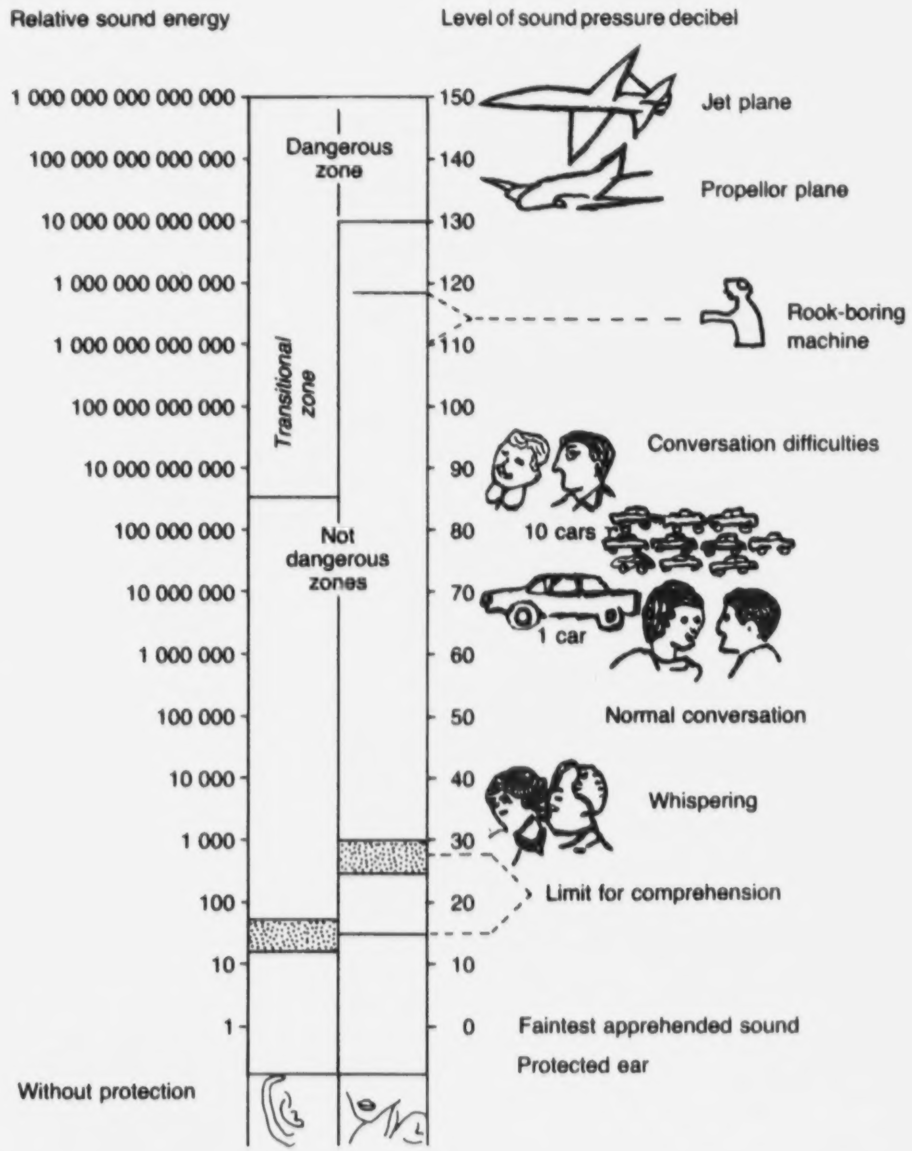


Figure iv shows various types of noise sources and their influence on human beings. The column to the left indicates the effect on an unprotected ear, while the column to the right indicates the influence upon a protected ear.

Source: Based on the chart produced by Dr. Lars Erik Ase, former Head of Geography Department at KSTC, NAIROBI

Combustion of fossil fuels also cause much heat. It is feared that increased heat and carbon dioxide in the atmosphere could cause a 'greenhouse' effect over the globe and give rise to climatic changes. Higher temperatures would melt ice in the Antarctic, drowning many coastal areas, where a large percentage of the world population live.

Other causes of physical disruption are the silting of water bodies and physical ugliness that impairs visual aesthetic perception. For example, improper dumping of solid wastes on land cause ugly waste strips especially in urban and mining areas.

GEOGRAPHICAL SCALE

Environmental problems have a geographical perspective. This would not change the nature under which we have discussed them but the causative and resultant factors could be on a local, national, regional or global level.

Local Level

The problems of a city or a village are local problems. Examples include discrepancies found within a city such as between slum areas and rich suburbs; congestion of people, buildings and vehicles in a city; waste disposals; water supply and housing; air and noise pollution; rural-urban migrations causing social disruption, too much pressure on existing facilities like education, job, market and health facilities. Most of the solutions can be found locally but others need national assistance as they arise from outside the city like the rural-urban migrations and problems of food availability.

National Level

Countries have environmental problems that are purely national and must be solved at that level. Such a problem is illiteracy. In many developing countries the illiteracy rate is as high as 80% and must be overcome if economic development is to succeed. Any society must be able to communicate effectively both within and among others in view of the nature of development today. Historical, cultural, social and economic factors have contributed to this problem.

Settlement types, localities and transport systems are also environmental problems of a local nature.

Regional Level

Several activities of a local nature could cause problems that encompass a whole region. Devegetation is taking place in many parts of the world - on mountains, slopes, on plains, along river-banks. However, devegetation in marginal lands has caused environmental problems of a regional magnitude. It causes desertification or the spread of desert conditions. The Sahara Desert for example is said to have claimed over one million square kilometres in the last 50 years. This is the Sahel, the land south of the Sahara. The five most hit countries are Mali, Chad, Upper Volta, Niger and Mauritania. Others like Ethiopia, Sudan, Somalia and Kenya have large tracks of arid and semi-arid lands on which live pastoralists. Traditionally, animals are a sign of wealth to pastoralists - not to be killed. They accumulate and overgraze. Development programmes in dry lands have provided water and veterinary services causing increase of livestock and overgrazing around water holes and settlements. When pastoralists migrate they cut down trees wherever they stop so as to build shelters for themselves and their animals. Introduction of the monetary system and taxation necessitates overstocking. Once the vegetation for both animal feed and fuel is gone, communities break up and people move into towns.

Solutions to desertification are expensive. These include development of regular pasture as well as watering stock from permanent wells; introduction of simple technologies that are compatible with the nature of the land and climatic conditions such as the use of the OX-plough rather than the tractors which expose a deeper layer of soil to high temperatures and high evaporation rate; more research is necessary to ascertain the nature of the climate, the effects of livestock and the effects of tradition on arid lands, the most suitable crops as well as finding ways and means of combating the problem. For any planning and development to succeed in these lands, getting the acceptance and participation of local people is vital. A lot of work has been done on a global level to combat desertification. At the UN Conference on Desertification in Nairobi, 1977, a plan of action was formulated. Unesco took the lead through its Man and Biosphere Programme. In conjunction with UNEP, and national Governments, Unesco has started integrated projects on Arid Lands (IPAL) to fight desertification. Natural disasters too are of local nature though where they occur they call for international assistance. Such are earthquakes, famine, destructive winds and floods. Solutions are usually on regional approach with countries of the region working together under the auspices of a relevant UN agency.

Global Level

Global environmental problems have their origin at the local or regional levels but affect the whole world. Examples are DDT spraying done locally for various reasons as mentioned elsewhere but DDT is now found everywhere in the world. This is because of the high mobility of the drug assisted by global air and water currents.

Carbon dioxide and heat in the atmosphere are of local origin but their effects could be global. When wildlife species become extinct, they are a loss to the whole of mankind not only to a country or region. In recent years people have recognized the dangers of exhausting energy sources. This realization has been brought home by the use of oil as a political weapon; drastic increases in prices of crude oil since 1973; the resultant increase of manufactured goods and decrease of raw materials, all culminating in an unbelievable rise in the rate of inflation. This necessitated the recent 1981 United Nations Conference on New and Renewable Energy Sources to look at strategies for developing and adopting renewable energy sources as an alternative to fossil fuels. Only a few countries of the world have nuclear power capabilities, yet, developments in the nuclear field are viewed with fear of accidents. Aircraft noise cannot be restricted to the country of origin of the plane.

SOCIAL, ECONOMIC SYSTEM

All environment problems have a social economic dimension. This is either because they are caused by the socio-economic systems or because their effects disrupt the socio-economic set up. Different countries have different socio-economic status and different life styles whose influence on the environment differ. Hence, the problems of developed nations are those of affluence. Examples include pollution of air, water and land. Diseases are of ecometabolic and physiological type and both individuals and nations have impressive facilities to care for the sick. Social welfare systems are well advanced and envied by those in the developing world. Problems of developing countries are mainly caused by poverty and the process of development made worse by illiteracy, a high rate of population growth and strict adherence to traditions, despite modern education. Diseases are mainly of pathogenic type and both the individuals and the governments are too poor to afford the desired treatment and associated facilities such as hospital beds. Social welfare systems are non-existent for the majority or just beginning.

Cultural factors in developing countries either create their own problems or hamper attemps to eradicate existing ones. The process of development can go on without causing serious environmental problems if ecological considerations are included at the planning level of all projects. Failing to do so, developing countries will inherit all the problems of developed societies as they continue to adopt their technology and lifestyles.

To summarize the prevention and solution of environmental problems is as complex as the environment itself and should involve all people. Environmental education for all levels will create awareness and commitment in individuals which will go a long way to prevent and solve environmental problems.

Environmental training will provide skills for environmental managers of all types charged with the maintenance of environmental quality such as water and sewage treatment, wildlife management and conservation of all resources. Community action is vital as some problems are communal while others occur at the national level.

International co-operation among nations and UN agencies, between the rich and poor nations is essential if environmental problems are to be minimized. Nations should be ready to learn from the mistakes of others for '... history repeats itself ...' while environmental ethics should not allow the exploitation of a nation by another. An example is the sale of dangerous drugs or in dumping toxic wastes.

It is clear that imbalance underlies all problems associated with the environment. The social science teacher and supervisor must ensure that they understand the nature of the interactions between the biophysical and socio-cultural environments in any given area and how they relate to the global situation. They must recognize the LIMITS in nature and direct human activities in ways which would make for environmental stability. The implications are heavily socio-economic as described above, decidedly political and involve a thorough re-appraisal of values and priorities. Environmental problems have their origin in HUMAN IDEAS and VALUES and hence it is in the realm of these ideas and values that prevention, control or solutions to environmental problems will be found.

Chapter 4

TEACHING METHODOLOGIES IN ENVIRONMENTAL EDUCATION WITH SPECIAL EMPHASIS ON PROBLEM SOLVING APPROACHES

Introduction

This chapter focuses on teaching methodologies in EE with special emphasis on the problem solving approaches. A model of instruction and associated methodology is presented at the beginning of the chapter. The rest of the chapter expounds on the various components of the model as it relates to EE.

When we accept the need for EE in-service training of teachers and supervisors we are saying that we have teachers who are competent in general knowledge, attitudes and skills expected of a competent educator or supervisor but who need the additional competencies pertinent to EE. Such are the knowledge, skills and attitudes necessary to achieve the goals of EE in the classroom and beyond. In other words, teachers have to produce in themselves and in their learners the affective, cognitive and psychomotor development that will ensure appropriate environment action through their lifetime and the lifetime of their pupils.

According to Richard J. Wilke, an effective EE teacher should be:

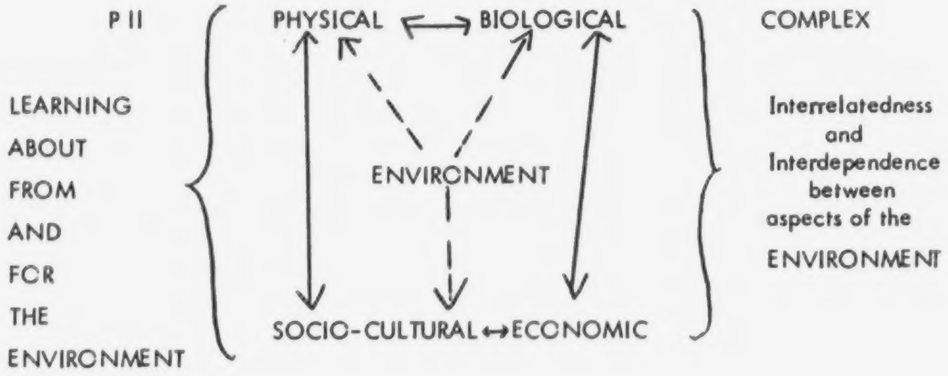
1. Competent in educational foundations and its application to EE; be able to relate educational goals with those of EE, utilize theories like moral reasoning, theories of knowledge, attitude and behaviour relationships, learning theories and transfer of knowledge in relevant fields of selecting, developing as well as implementing EE curricula and curricula material.
2. Competent in EE content in the field of ecological foundations, conceptual awareness, investigation, evaluation techniques and action skills that will enable him to take positive action so as to achieve and maintain equilibrium between the quality of life and the quality of the environment and be able to make others do likewise.
3. Competent in environmental methodology as well as in planning and evaluation of EE curriculum (Unesco, 1980).

To do so, teachers need to understand the EE methodology which involves a holistic conception, accommodation of modern educational ideas based on participation, research, experimentation, interdisciplinary techniques geared towards actual problem solving; the evaluation of responses to real situations or problems and team work; they should be able to utilize the immediate environment as resources for learning and have the ability to bring the school into contact with the community.

METHODOLOGY

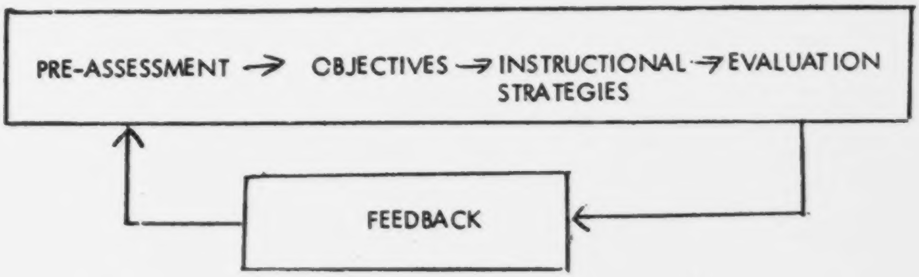
A study of the environment in its totality is a new concept and each of us must learn to perceive of ourselves as part of a total system. Refer to diagram 17 which summarizes this concept of TOTALITY.

Diagram 17 : THE ENVIRONMENT IN ITS TOTALITY



The learning referred to in diagram 17 is as complex as the environment itself and makes it necessary for teachers to be able to clearly conceptualize what they intend to do, why and how they intend to do it. This should be communicated to the students. The authors have used the following model adapted from the general teaching method, to which the students are introduced in summary form during the first lesson.

Diagram 18: MODEL OF INSTRUCTION



The next few pages will expound on the various components of the model as it relates to EE.

Pre-assessment:

A pre-assessment exercise has two objectives:

1. To give teachers an idea of the level of environmental awareness of the group to be dealt with;
2. To rouse the interest of students in environmental matters.

A simple pre-assessment form could be designed and items modified for different groups.

Example One:

Kenya Science Teachers College

Pre-Assessment Form

NAME :

CLASS:

Answer ALL Questions:

(1) What do you understand by the term 'Environment'?

(2) What do you understand by the term 'Environmental education'?

(3) List five major environmental issues/problems of concern in your country.

(4) What international body does UNEP stand for?

(5) Why should secondary school teachers be concerned about environmental issues?

(6) List down five topics you would like to study.

Example Two:

The following is an awareness survey which could be used as it is or altered to suit the students' background:

ENVIRONMENTAL AWARENESS STUDY

Participants : Group Activity; 14 years-adult

Time : Approximately 5 minutes per person; open-ended follow-up.

Description : Designed to measure community awareness of environmental issues and the impact citizens feel they have on community decisions.

Materials : Copies of questionnaire
Overhead projector.

Please circle the answer of your choice at the left of each question:

ANSWER:

1. Do you feel a personal responsibility to work for the improvement of your environment?

1. a b — (a) yes (b) no

2. When you come upon a newspaper story about an environmental problem, do you read it?

2. a b c — (a) yes (b) no (c) sometimes

3. All other factors being equal, would you be more or less likely to vote for a local political candidate who supports environmental planning?

3. a b c — (a) more likely (b) less likely (c) makes no difference

4. How much power do you think you have in influencing local government?

4. a b c — (a) a lot (b) little (c) none at all

5. Some people think that solid waste disposal is one of the major problems facing this country. They feel that because we are using up our resources at a rapid rate, we should be reusing or recycling our garbage, which contains many materials that are now becoming scarce. Now, how do you feel? How serious a problem is solid waste disposal and recycling ?

5. a b c — (a) very serious (b) serious (c) not serious

6. Are you doing any recycling nowadays?

6. a b — (a) yes (b) no

7. If so, which materials do you recycle?

7. a b c (a) glass (b) paper (c) other

8. Would you like to know more about environmental issues?

8. a b (a) yes (b) no

The results of the survey could then be summarized for analysis and written on the chalk board or on a transparency for use on the overhead projector. A discussion then follows.

In discussion, the following points could be reinforced:

1. The need for responsible behaviour by each individual citizen towards the environment.
2. The need to keep informed about current environmental problems and issues and identify real problems where action can be taken.
3. The need to encourage leaders who insist on environmental considerations in the planning of development projects. In this way environmental problems can be lessened.
4. The need to minimize solid wastes and whether comparable situations exist at the home or school level. This highlights some of the problems we directly contribute to.
5. The need to recycle materials on an individual, local or national basis. We must stress the resource conserving ethic and the concept of cycling of materials in nature.

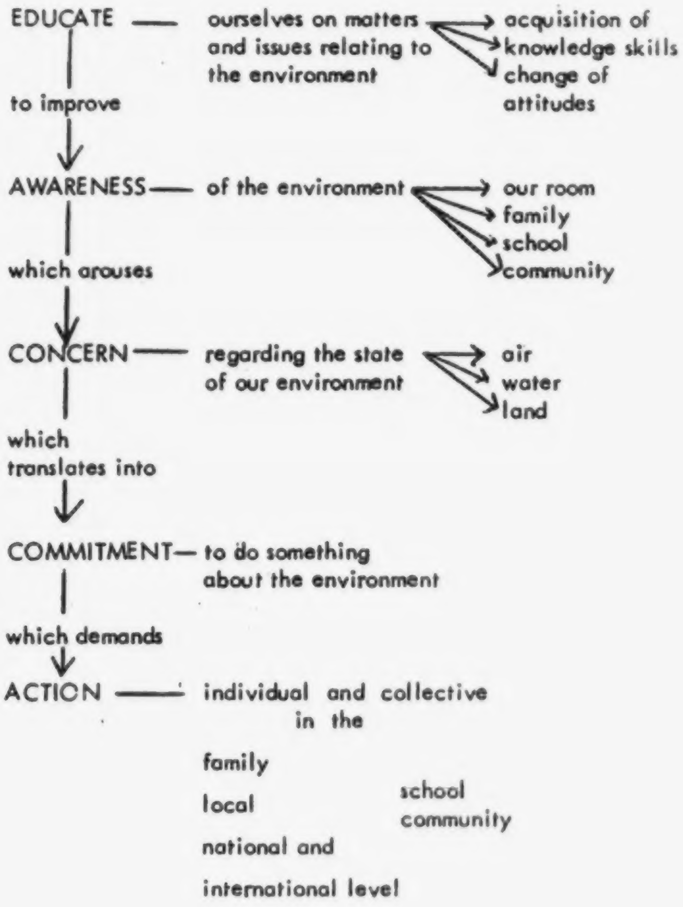
This can indicate the type of action each one of us can take, such as using recycled paper.

Such a survey also enables the participants to see physically how their attitudes and values relate to those of the rest of the group. This is one way of developing good interpersonal relationships among the participants.

OBJECTIVES:

The objectives of EE should be very clear to the teacher and supervisor, who would in turn explain them to the students at the very beginning. Refer to diagram 19.

Diagram 19 : A SUMMARY OF ENVIRONMENTAL EDUCATION OBJECTIVES


EDUCATE — ourselves on matters and issues relating to the environment
acquisition of
knowledge skills
change of attitudes
to improve
AWARENESS — of the environment
our room
family
school
community
which arouses
CONCERN — regarding the state of our environment
air
water
land
which translates into
COMMITMENT — to do something about the environment
which demands
ACTION — individual and collective in the
family
local
national and
international level
school
community

INSTRUCTIONAL STRATEGIES

A teacher or supervisor who is competent in EE should be able to realize that EE methodology is not completely new. It brings together many techniques that have been developed in other areas for their effectiveness in achieving EE goals.

The use of different methods is brought about by two factors:

1. that whatever is being learnt goes beyond any traditional discipline;
2. that the teacher has to achieve set goals (i.e. goals of changing attitudes, social participation, commitments, development of skills, value clarification).

The teacher may use one method or a combination of methods to achieve one goal. Whatever methods are selected, they should be active, involve students (student participation) provide facilities for students to experience, wholly or partially, the environment either actual or simulated in the classroom or outdoor, and also be factual in element. The methods should also be in depth and survey in approach while the instruction put across should be interdisciplinary as mentioned elsewhere. As EE is problem-oriented, students should learn to scrutinize environmental problems that affect them, the community, the nation and the world as a whole. They should be able to suggest possible solutions and draw up a plan of action. This calls for the adoption of the problem solving approach.

The problem solving approach: It allows for use of different teaching techniques to solve a problem. It trains students to work individually and in groups. It helps them to acquire skills of extracting information using equipment, planning and conducting interviews, discriminating against information collected and making conclusions. Solutions to problems require people who have developed a mental attitude that will allow them to make a choice of the most appropriate skills and solutions based on available facts and a critical analysis rather than based on personal opinion - who will learn to listen critically (constructively) to other people's ideas and to change their own attitude if necessary. The problem solving approach is two pronged: the discussion technique and the project technique.

A. The discussion technique:

It provides a defined problem to be studied which the teacher states. Students get guiding questions which they answer individually or in groups, in or out of school (could make part of students' homework). The discussion takes place during a general session where students answer to guided questions are discussed. The teacher guides the discussion to avoid irrelevancy and waste of time. To carry out this technique adequately, students need immense resource materials. This is a constraint in many cases.

Example 1

Participants	:	Group activity. 14 years-adult
Time	:	Left to the teacher
Description	:	Designed to make students understand that any position on the human population has personal, social, ecological, political and economic implications.
Materials	:	Copies of questions for each group.

Procedure :

(a) Prepare four sheets with 2-4 questions each.

Group 1 :

(i) Should all people have the freedom to have as many children as they want?

(ii) How does the expanding world population (3.7 billion in 1974 and 7 billion by 2000 at present growth rates) affect yourself now and in the future?

Group 2 :

(i) With one country consuming 50% of the resources used in the the world, how do you see developing countries reacting towards that country? How does this imbalance lead to political instability?

(ii) If everyone continues to live just as they do, today, what kind of world can your children look forward to? Will there always be enough to go round?

Group 3 :

(i) Are birth control policies normally right only when decided by an individual? Is there such a thing as society morality? Do religious beliefs influence such decisions?

(ii) Do you see human population as a central issue underlying other environmental problems? What is meant by population applying a magnifying effect upon environmental problems?

Group 4 :

(i) Some people feel that wars, disease and natural disasters will control population surplus. Do you agree with that? Give a few examples. Have human populations gone beyond natural controls as we know them now? What kinds of future control will the world population suffer if we continue to grow at the present rate (doubling every 30-35 years)? Remember, the world has only finite resources and population control will occur sometime either by ourselves or in spite of ourselves.

(ii) As population increases, family ties generally weaken. Old people used to be the most respected and the most honoured people. This is still so in rural areas but it is dying out among the urban modernized population. In the near future, the life of the aged is going to become very difficult. Unlike the industrialized societies where social welfare schemes cater for the aged and retired, in most developing societies very few of the aged will have a pension. Most will depend on their small agricultural crops or families. Many of their children will have dispersed into the towns and other areas. Is the current trend towards family disintegration inevitable as populations increase? Do the aged have the same rights to a quality environment as everyone else? How is the quality of life different today for the aged than for younger people in (a) a developing society? (b) a developed society?

(b) Divide the class into four groups (the teacher may like to have 6-8 groups, depending on the size of the class), and have them write answers to their questions followed by a group discussion of their questions. Some records should be kept in each group to list important points to remember for class discussion.

(c) After group discussions, bring the class together to discuss the 8 questions, sharing out each group's initial discussion.

Discussion Questions:

(i) Was your class or group able to come to an agreement over any or all of the questions? If not, think about how difficult it is for governments to ever reach equitable or just decisions for their society.

(ii) Is it necessary for students of your age to consider questions like on this activity? If it isn't, when will it be necessary?

(iii) If you were given one million dollars (or equivalent currency) tomorrow, would you feel it necessary to consider questions like the ones in this activity, or would you feel right in doing as you please, not thinking about the world tomorrow?

(iv) Do you feel population should not be considered in schools and colleges as it is simply too personal?

Example 2

Participants : Individual and Group Activity, 13 years-adult

Time : 40-60 minutes

Description : Designed to develop skills in the students by the use of pictures. In particular, the skills involved are three:

1. the ability to recognize a problem;

2. the ability to define a problem;

3. the ability to generate alternative solutions.

Materials :

1. Pictures, which show a problem. These may be cut from old calendars or magazines. These may be secured by the students or supplied by the teacher. The pictures could focus on such

topics as natural disasters, pollution, depletion and degradation of natural resources, hunger, settlement, transport, unemployment, and wars (the latter to illustrate environmental degradation).

2. An opaque projector to project the pictures on a screen (if necessary).

3. Pencil and paper.

Procedure:

(a) Project the pictures on a screen or pass them among the students.

(b) Ask the students to number their paper to correspond to the numbers on the pictures.

(c) While viewing the pictures, the students answer the following questions:

  (i) What problem does the picture suggest to you?

  (ii) What are several solutions to this problem?

(d) Give the students 3-4 minutes on each picture.

(e) When the list has been completed, view each picture again, and discuss and compare the alternatives.

Discussion Questions:

(i) Could there be any other environmental problems suggested by these pictures?

(ii) What do you suppose caused these problems?

(iii) Would other environmental problems be created by the solutions which you and others suggested?

(iv) Would you be willing to sacrifice some comforts to solve these problems?

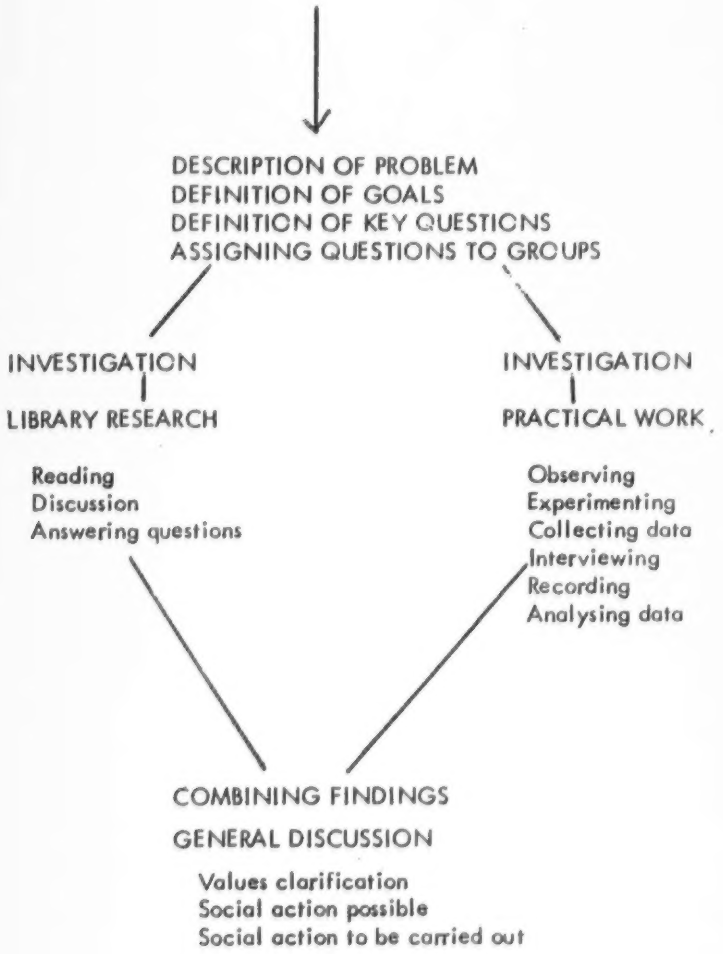
B. The project method:

The project method shown in diagram 20 allows for groups of two to three to work together and develop skills of collecting, recording and analysis of data of both literary and oral nature.

Students concentrate on the various aspects of a well-defined goal - each group working on the subdivision of the whole. Projects must be meaningful and relevant to the students' background and in keeping with the school curriculum.

The most important part of the project is the practical work carried out in an appropriate place like the weather station, historical monument, miniplot, a place of worship, along the road, or in the laboratory. In these or similar places depending on the project, the students work to develop skills of observation, sampling techniques and measurement, as in a water pollution study, recording of data such as in weather observation or traffic census and the drawing of conclusions. To be meaningful, a project should culminate with a presentation in the form of a report, photographic display, exhibition, demonstration or seminar.

Diagram 20 : THE PROJECT METHOD



Example 1

Participants : Individual activity 13-adult

Time : 45-90 minutes (in two sessions)

Description : Designed to find out through library research how deserts can result from human activities studying case histories from past situations.

Materials :

1. Pencil and paper.
2. Access to a library-encyclopedia, resource text, magazines.
3. Filmstrips on the geography and cultures of Asia Minor and North Africa.
4. Film projector and UNEP films: 'Firewood' and 'Deserts and Man'.

Procedure :

(a) Students are asked questions about what happened to the great civilizations that once flourished in Asia Minor and North Africa. For example:

   (i) What happened to the once very productive Tigris-Euphrates Valley?

   (ii) What happened to the agricultural lands surrounding ancient Carthage?

   (iii) What happened to the land when the Biblical Cedars of Lebanon were cut ruthlessly?

(b) Students are then given time to research either in the library, or in the class by use of filmstrips.

(c) Each student in the class is then encouraged to look at the kind of problems involved. For example:

   (i) The students research on the importance of forests in moderating temperature and in building the soil on steep slopes.

   (ii) The students review what happens to irrigation projects when waterways become heavily silted.

   (iii) The students try to find out about the damage to ground cover caused by overgrazing with sheep, goats, cattle. They are referred to the findings of UN 1977 Conference on Desertification. Screen UNEP film: 'Deserts and Man'.

(d) Students then write up their findings in a report, making use of tables, sketches, pictures etc. and present them to the teacher.

(e) Teacher may then comment on the results of the project and initiate class discussion by way of conclusion.

Discussion Questions:

(i) What evidence can be found to support the contention that deserts can be caused by human activities as well as by climatic changes? To follow up show the UNEP film 'Firewood'.

(ii) Is it possible to create deserts in any area? Where? How?

(iii) What can and/or should be done about this major environmental problem?

EXAMPLE 2

Participants : Group activity 14-adult

Time : 80 minutes (2-3 sessions)

Description : Designed to investigate the reasons why an ever increasing number of people need medical care and hospital facilities, despite improvements in nutrition, sanitation and protection against heat, cold, humidity and physical fatigue.

Materials :

1. Resource persons from the Ministry of Health (MOH) and WHO.
2. Slides and transparencies and felt pens.
3. Slide and overhead projector.
4. Pencil and paper.
5. Tape recorder and tape (interviews).

Procedure :

(a) Students are informed about the different types of diseases such as acute, chronic, infectious, etc.

(b) A resource person from the MOH is then invited to give a historical perspective of the disease in your country for the last fifty years. (Slides and transparencies are used.)

(c) The students then divide into groups of 2-3 and selecting a particular disease e.g. cancer, cholera, etc., try to trace the leading cause of that disease and death in your country. They may interview local clinical personnel e.g. school nurse.

(d) Students then get statistics of the incidence of the disease chosen both in the country and on a global basis from the WHO representatives.

(e) Students then summarize the findings of their investigation in a report. Active encouragement is given to the use of audio-visual aids e.g. graphs, sketches, interview recordings in their class presentations.

In their presentations the students should be encouraged to find out the marked differences in occurrence in different regions. Possible explanation could then be sought in both the physical and social-cultural environments illustrating the linkages between them. Factors to consider would be climate, water supply, overcrowding, diets and cultural 'taboos', occupations, traditions, economic status and the age structure of the community.

Teaching methods utilized through problem solving approach:

Each of the problem solving approaches could effectively utilize some or all the teaching methods described below.

A. The Lecture

This is the method by which teachers tell students what they know. It is used to provide facts by an individual teacher or guest speaker, each dealing with a particular aspect of the environment. For example, lectures by experts from relevant fields may include the Curator from the National Museum to speak on 'The Historical Development of a Culture', the pastor to speak on 'The Hazards of Smoking and Drinking', the town planner to speak on 'The Rehabilitation of Slum Areas' and the Mayor to speak on 'Civil Responsibilities' in ensuring a just, happy society in a quality environment. Those topics which relate directly to the daily life of the students are most popular. Teachers should guard against boredom by using a variety of teaching aids such as pictures, slides, films, charts, tapes, diagrams and the chalkboard. To be most effective, each lecture should last a maximum of 40 to 50 minutes, after which the students can ask questions.

B. Outdoor Education Methods

EE moves away from traditional classroom learning by more use of outdoor activities. These would include field trips done within the framework of a project or to collect data for discussion purposes. They are an excellent means of observing and experiencing the real environment.

Field trips stress the investigative skills of observing and measuring, and the diagnostic and decision making skills of analyzing and synthesizing. They are an ideal method for increasing environmental awareness and for stimulating participation in community action.

Field trips can be organized to investigate any environment. It is flexible in that the focus of the excursions can be varied to illustrate the various components of an environment or to build an understanding of the interaction processes between components.

For example, a field trip arranged to study a part of the savannah in Africa (or any other area) may observe the following: the distribution of plants and animals and their relationships; the predator-prey relationships; food chains and foods; the effects of human activities such as burning, overgrazing; the soil and climatic conditions on a macro and micro scale and the effect of these interactions.

A field trip to a factory may study the following factors: the raw materials used in the production; the processes of production; the human resources - sex and numbers and age; the working conditions - pay, hours, noise levels, sanitation, safety precautions; the disposal of wastes; the protection of consumers - quality control; the location of the factory in relation to the social environment and availability of resources.

As field trips are time consuming and can be expensive, to be successful they must be well organized. They need to include the co-operation of the staff and the community when necessary. All field trips require a series of lessons. The basic steps in preparing and carrying them out are similar but the details of observations, measurements, interactions will be different.

Generalized guidelines for field trips include the following:

1. Reconnaissance trip by teacher to the site previous to the actual activity is essential.

2. Preparation for the trip: these include a clear statement of the objectives and the discussion of the content. Students are informed what location is to be visited and what to look for. Stimulus materials e.g. pictures, films, maps, are provided and any other relevant information got during a reconnaissance trip by the teacher. The procedure is then outlined and students are exposed to any new technique or equipment they might use.

   These may include the use of a questionnaire, sketching or use of a hand lens or meter rule. If there are any specimens to be collected, this issue is then explained.

3. In the Field

The students are reminded of their code of behaviour in the field, and not to damage plants or animals unnecessarily.

This is a good opportunity to develop an attitude of caring for the environment and other people's property. Safety aspects are emphasized and it is essential that a tutor accompany the group. At the selected site, general observations of the areas by the class are noted. Groups should then be allocated specific tasks to collect data. These may include drawing a 'map' of the site, marking physical counts of shops, churches or cars. Each group must have a record to write down all the observations otherwise information might be lost or tend to be inaccurate if properly done, thus allows the participation of each student using the variety of abilities and talents present in the group.

4. Follow-up Work after the Trip

This should be as soon as possible after the actual trip. Observations are studied and relationships examined with a special evidence of environmental stress and the reaction of plants, animals and people. This phase of work is where students may need guidance. The follow-up activities should stress the recognition of interrelationships, trends, the predictions of patterns of development and/or growth and the consequences for the environment, in particular and in general. An environment studied over a period of time should lead students to our appreciation of the concept of 'balance' or 'dynamic equilibrium'.

5. Preparation of a Permanent Report

This helps to improve students communication skills and perceive important relationships from their observations. The record might include a written outline of steps followed in the investigation, the way of illustrations, graphs, photos, a map or sketch and an analysis of the effects of human occupation and activity in the area.

6. Community Display

A display of the material is organized and all parts of the school and community and united. Class members explain the exercise to their peers. This builds interest and confidence and the questions asked would generate ideas for further study. This would also provide an opportunity for the increasing community understanding of the local environment.

Suggested examples of field trips include investigations of an urban environment, a historical site, the pattern of buildings in a town, or a terrestrial or aquatic ecosystem.

The following is a summary of generalized guidelines for field trips:

1. Reconnaissance Trip by Tutor to Site
   - selection of environment for investigation
   - general overviews.
2. Preparation for the Trip e.g. Classroom, Laboratory
   - state objectives
   - discuss content
   - outline procedure
   - exposure to equipment/techniques
   - collection of specimens e.g. plants, animals.
3. In the Field
   - code of conduct
   - safety aspects
   - tutor escort
   - overall picture
   - allocation of specific tasks
   - record of data.
4. Follow-up Work after the Trip
   - immediate after trip
   - analysis of data focus on relationship/trends impact of man
   - tutor guidance necessary.

5. Preparation for a Permanent Report

   - written or taped record improves communication skills
     reinforces learning in the field

   - illustration of relationships drawing of sketches/maps
     charts, histograms
     photographs slides

   - preparation of specimens

   - report analytical findings of human impact in area.

6. Community Display of Material

   - general interest and stimulates action.

Code of conduct to be observed during field activities:

1. Leave only your Footprints Behind

   Litter destroys the appearance of an area. Always wait to find a dustbin or garbage bin before discarding rubbish.

2. ENJOY! DO NOT RE-ARRANGE!

   Trampling vegetation, removing logs and stones, and throwing rocks may destroy or disturb the homes of animals stripping bark from a tree will kill it.

3. Disturbance May Mean Death

   Do not disturb birds or other animals, or try to pick up their eggs or young. A frightened animal may desert its off-spring, leaving them at the mercy of the predators.

4. Taking Notes and Photographs Not Specimens

   Some collecting may be necessary, but never take more than you actually need. Wild plants and animals thrive best in their natural environment. Never dig up wild plants for your garden or pot plants. Picking wild-flowers prevents them from seeding and may lead to a decline of that species.

   If you pick up a live specimen, such as an insect to take a closer look at it or show it to a friend, return it unharmed to its original setting.

5. TAKE IT SLOW!

   Learn to stop, look and listen to the wonders of the world about us.

EXAMPLE

Participants : Individual activity 13-adult

Time : Part of a day 2½-3 hours

Description : Designed to investigate why and how water is treated before use by any society by visiting the local water treatment works.

Materials :

1. Clipboard, pencil and paper.
2. Official permission in the form of a letter.
3. Camera with film.

Procedure :

(a) Students are briefed on objective of the visit i.e. to investigate why and how water is treated before use.

(b) Distribution of questionnaires to each student. (A questionnaire serves to guide the students to concentrate on relevant information.)

College/School heading

Name:

Class:

Visit to the Water Treatment Works

1. When was the works built?
2. How much water comes into the works each day?
3. List the sources and the amount each provides.
4. How much water is supplied to the City (town) in a day?
5. Using simple sketches, explain briefly what happens:
    (i) at the inlet;
    (ii) in the sedimentation tank;
    (iii) in the filters.
6. What chemicals are used to sterilize the water and adjust the pH?
7. Why is it necessary to do this?
8. How is the water distributed?
9. What environmental problems can arise in this water supply system?

(c) Students visit the water works and are taken round by the water superintendant - a resource person.

(d) Follow-up discussion occurs in class with slides or photos taken during the trip and chalkboard sketches.

During the discussion, the need for treating water is stressed and hence the payment for water consumption is justified, and the need to conserve this vital resource is stressed.

C. Methods of autonomous student or group investigation, evaluation and action planning:

This is carried out through experiments in the laboratory (tests on soil properties or water samples), or miniplots (use of different fertilizers on crops) or other urban environments to develop skills of observation, sampling techniques, measurements and recording of data analysis and conclusions such as in a traffic survey.

D. Values clarification:

Effective education methods should be geared towards values clarification. The complexity of our times means that all of us are required to make decisions affecting ourselves, the community, the nation and the world. These decisions which relate to the environment involve choices. The act of choosing becomes exceedingly difficult in many environmental decisions. Ideally choices are made on the basis of one's underlying values. Too frequently many people, particularly young people, are not clear about their own values.

The values clarification method is aimed at helping students to become more aware of their own beliefs, attitudes and values; to consider and weigh the pros and cons and consequences of various alternatives; to consider whether their actions match their stated beliefs and if not, how to reconcile the two; and to try to give students options in and out of class, for it is when students begin to make their own choices and evaluate the actual consequences, do they develop their own set of values (Stapp and Cox, 1975). The mental processes involved are analysing, comparing and prioritising values clarification teaching strategies include role-playing, simulation, situational analysis, debates and discussion.

EXAMPLE

Participants : Group activity 14-adult

Time : 2 lessons (40-80 minutes)

Materials :

1. Worksheets with the problem
2. Pencils and paper

Description : Designed to see if students can suggest alternatives to a problem by use of a situation analysis strategy.

Procedure :

(a) Students are given the problem

The problem

You are a resident of a small but popular seaside resort. The soil is not good for agriculture so much of the food has to be imported at considerable cost. The bulk of the earnings come from the hectic tourist trade. Tourist attractions include beautiful sandy beaches, coral reefs with their marine reserves, deep sea fishings. The rich are hoteliers and tour operators. Some residents make a living out of fishing, handicrafts and supply of tropical fruit.

Recently oil has been discovered offshore. The government is considering whether to extract it or not.

Questions

What would you advise the government to do? Why? What actions would you take to ensure that your advice is followed?

(b) Students are divided into groups and told to discuss the problem as a group activity. The students should be able to state the requirement for a successful tourist trade, and some of the benefits and hazards of drilling oil offshore.

(c) Groups report their findings to the class at the end of a timed discussion. The various suggestions made by each group are then assessed by the class as a whole. At this stage, the students should be able to compare findings and establish environmental priorities: make reasoned judgements as their feasibility.

Discussion Questions :

(i) How effective are the proposals for the protection of the marine environment?

(ii) How easy is it for the government to develop this resource?

(iii) How feasible is the financial situation?

(iv) What would be the social cultural repercussions in terms of:

- employment opportunities;
- increased inflation e.g. property, clothes, food items, luxury goods etc.;
- imported values and attitude;
- recreational and other amenities for the people;

- some of the attitudes that should have emerged include a willingness to:
  - work together in a group;
  - be tolerant of other people's ideas;
  - clarify their values through discussion with other groups;
  - act on discussions taken;
  - assist the government in carrying out its task.

It should be stressed that the main objective of such a method is to reinforce an attitude, value or to change it and acquire a new one.

With each of the above methods can go relevant films, photographs, slides, filmstrips, video, slide tape presentations and the use of newspaper cuttings.

E. Instructional Simulations and Games:

These methods are effective in fostering attitude formation or attitude change through a free and frank exchange of ideas and values between and among the students and the teachers in a classroom situation. The selection of the activities will determine their usefulness in EE. It is noted that such methods will encourage attitudes of caring, a willingness to act, a commitment to life sustaining rather than life destroying thought and action and a sense of interdependence and relatedness.

Simulation activities or role playing are effective in training students in environmental decision making. They learn to use a problem solving procedure and by assuming the 'role' or 'shoes' of responsible positions in society, they begin to understand why making decisions about environmental problems is complex, time consuming and sometimes difficult to take action because of so many divergent variables. Interaction and value conflict among individuals and groups can be a major deterrent to decision making.

EXAMPLE

The students select a project that is going to help the community in which they live. People are their first concern. Having made tentative plans they must now evaluate their project. One method is to check the strong and weak points - that is to role play the different interest groups. This involves students putting themselves in the 'shoes' of the seller and the buyer (e.g. civic clubs, businessmen, housewives, clergy etc.).

The role playing can be done in any of the following ways:

1. The class is divided into five groups. Four of these groups will represent the special interest groups like the city commission, the boy scouts, the Rotary Club, the housewives, and the fifth group represents the sellers of the project. Members of the fifth group will go to each of the other groups to 'sell' their project. Students representing the special

interest will raise reasonable arguments as to why the project is unrealistic or will not work. They are then discussed within the groups to see which of them really presents an obstacle to the implementation of the project.

2. The students work in pairs with one person selling the project and the other, identified as a representative of the special interest group, gives reasonable arguments against the project. The students are given approximately 5-10 minutes and then exchange roles. The students are asked to take notes on any new perception about the project.

Games involve both competition and co-operation as well as chance. Their creation is challenging but occasionally it is worthwhile to involve students in this activity.

Games related to the environment such as, in combating poaching of wildlife dealing with land-use conflicts, speculating over homes and business premises, will develop mental skills as well as increased awareness and understanding. These could vary in their demand on players, and could range from word puzzles to field activities. Refer to the 'Energy Bingo' activity in next chapter.

F. Community Resource Use:

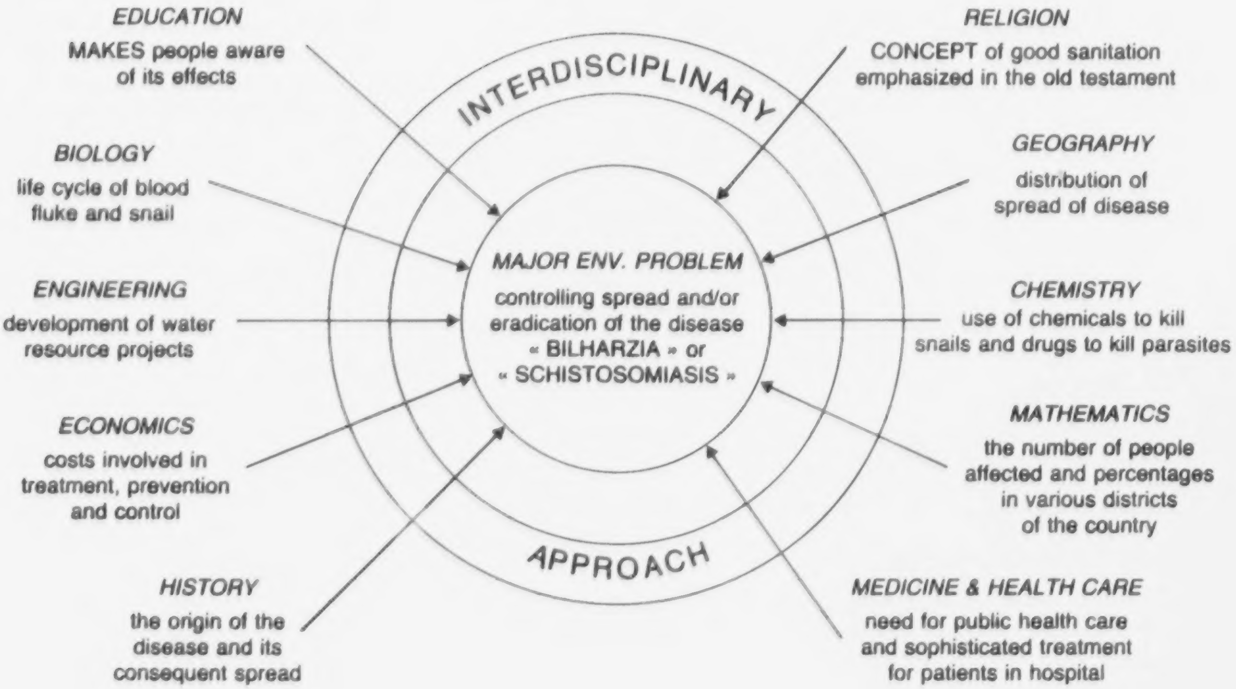
EE can make effective use of the community for learning by approaching realistic problems in a practical manner. These problems usually relate to the social needs of the community or could be of an aesthetic nature to beautify a particular area such as to plant trees around a school. The student could be involved in some rural development self-help projects like collecting money to build a water tank for a school, improving latrines or teaching people to read and write in the developing countries or helping to build and run a recreational centre and organize recreational activities in a particular community or providing care for the aged and sick, or raising funds to assist disaster struck areas of world in a developed society. This provides an opportunity for students to be out of class and in contact with the community.

The approach to the teaching of EE should be interdisciplinary: in view of the complexity of problems facing the world today, society can no longer be satisfied with a single discipline oriented education. Hence the adoption of an approach by EE that encompanes without wasteful overlap.

Inputs by the different subject areas can be at the preparatory level (of content materials) or at the teaching level (by specialists in the relevant areas being discussed).

Below (refer to diagram 21) is an example of how knowledge from different subject areas of consultation can be used to solve a single problem.

Diagram 21: An example of the interdisciplinary approach used in EE


EDUCATION
MAKES people aware of its effects
BIOLOGY
life cycle of blood fluke and snail
ENGINEERING
development of water resource projects
ECONOMICS
costs involved in treatment, prevention and control
HISTORY
the origin of the disease and its consequent spread
INTERDISCIPLINARY
APPROACH
MAJOR ENV. PROBLEM
controlling spread and/or eradication of the disease « BILHARZIA » or « SCHISTOSOMIASIS »
RELIGION
CONCEPT of good sanitation emphasized in the old testament
GEOGRAPHY
distribution of spread of disease
CHEMISTRY
use of chemicals to kill snails and drugs to kill parasites
MATHEMATICS
the number of people affected and percentages in various districts of the country
MEDICINE & HEALTH CARE
need for public health care and sophisticated treatment for patients in hospital

EVALUATION : A process that serves as feedback for the teachers and students alike to show whether learning has taken place. The teacher can then reinforce or change the methods he was using. The mode of evaluating students should be understood by them at the onset of the course. In many countries evaluation will be formal in the form of quizzes, tests and examinations because the countries' educational system is examination oriented. In other cases, the evaluation of students in EE has taken the form of three components:

1. Continuous assessment.
2. A practical project.
3. Final examination.

each component is worth 100 marks. As long as the students are aware of whatever form their evaluation will take, there should be no problem.

Chapter 5

SUGGESTED EXPERIMENTS AND ACTIVITIES TO FACILITATE THE TEACHING AND LEARNING OF THE ENVIRONMENTAL DIMENSION OF SECONDARY SCHOOL SOCIAL SCIENCE SUBJECTS

Introduction

This chapter outlines some experiments and activities to facilitate the teaching and learning of the environmental dimension of secondary school social science subjects. Emphasis is given to the continuous development of certain basic skills such as reading, questioning, communicating and the interpersonal/social skills. The use of groups or a co-operative basis is encouraged using the problem solving approaches, with visual aids and resource personnel wherever possible.

ACTIVITY I

TOPIC: My Coat of Arms

Concept : Values clarification

Objectives : To enable students to clarify and think about:

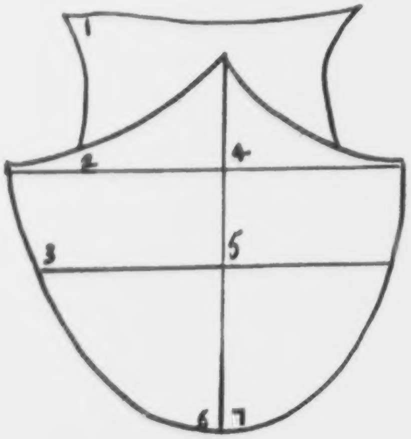
1. their values;
2. where they are heading to;
3. the impact their values have on their life and that of others.

Materials :

1. chalkboard;
2. pencil, paper, rubber, crayons.

Procedure :

(a) Students draw their own coat of arms and divide it into numbered segments as below:



(b) Students then fill in each segment with a symbol to represent their values. Guidance is provided by the following questions:

(i) one value to which you are deeply committed;

(ii) how your life would change if you won one million dollars (or equivalent) in a lottery or football pools or inheritance;

(iii) your greatest action for the environment in the last year;

(iv) your material possession of most value;

(v) your greatest success symbol;

(vi) something you are striving to obtain (material personality trait);

(vii) one thing you are thankful for.

(c) A few coat of arms are selected and discussed in class. Through the discussion, students are encouraged to think about some important value questions that can later make them react to environmental questions and in a more positive manner. This is an enjoyable activity for students and later the best 'coat of arms' are displayed for others to admire and learn.

Adapted from Stapp, A.B. and Cox, D.A., 1974, Environmental Education Activities Manual, Vol. V, page 148.

ACTIVITY II

TOPIC : Analysis of Newspaper Reports on Environmental Problems

Concept : The solution of environmental problems is helped by application of reliable knowledge from many different subject areas.

Objectives : The students should be able:

1. to state the environmental problem being studied;
2. to discuss a newspaper article or articles critically;
3. to make choices between alternatives;
4. to predict consequences of problems studied if they remain unsolved;
5. to present their critiques to the class.

Materials : Reports or articles from local newspapers for analysis. Refer to pages 78 and 79.

Procedure :

(a) Students read each article and state the environmental problem being discussed.

(b) Students then consider what the consequences might be if the problems are not addressed.

(c) Students then discuss critically any solutions offered in the articles.

(d) Students then consider alternative measures, if no solutions are suggested, giving their reasons.

Advertising Feature

The diseases of development

MALARIA INCREASING IN MANY COUNTRIES

DEVELOPMENT activities like the construction of dams and water reservoirs has increased the occurrence of certain diseases in some parts of the world. In this article *ARUN BHATTACHARJEE* discusses this problem.

THE concept of development has changed in the past decade as its side effects in terms of health and environment became better understood.

When the famous Aswan Dam was built in Egypt, the planners hardly thought it could bring the dreaded schistosomiasis (snail fever), something thought not totally alien to Egyptian soil was localised. The Volta dam in Ghana is having similar effects on the health of the people though the dams economic impact on the countries are considerable.

Similarly, malaria which vanished in the post-war years in India has made a comeback and with such a ferocity that more than 8 million people were affected last year. In 1968 there were three million cases of malaria in Ethiopia, with more than 150,000 deaths.

Many people ask how malaria could come back after so many years. How could there be schistosomiasis or filariasis in areas where there was none before? While physicians and scientists went on experimenting with powerful drugs for' these, particularly malaria as the strains became resistant to common quinine, the environmentalists came out with a different answer.

They found that the return of all these diseases directly relates to the creation of favourable habitats for their breeding and survival. And these habitats largely relate to the development efforts of nations such as erecting dams, creating vast water reservoirs and digging irrigation canals where mosquitoes can breed and the schistosomiasis harbouring snails thrive.

Onchocerciasis is another deadly disease which can be contracted from the black flies which breed in the foamy and cascading springs and dam spillways. Their bites could induce blindness in a person over the years. The disease is commonly known as river blindness.

The answer was to spray more DDT, more Malatheon to destroy the breeding grounds of mosquitoes and physically kill the snails. But it did not work out as spraying contaminated the limited fresh water system and caused environmental hazards. It is now almost impossible to destroy all the schistosomiasis harbouring snails.

Environment and health experts came up with the idea of destroying their habitats by environmentally controlling the vector diseases. Some of those like bilharzia (snail fever) cannot be traced, in the early stage by the commony accepted skin tests. When the symptoms become apparent, it is often too late to treat a patient.

In case of filariasis common blood tests do not often indicate the disease's existence in the body unless the blood samples or smears are taken in total darkness when these show in the blood streams.

Between 1973 and 1977 there were forty deaths due to malaria in the Federal Republic of Germany which had had no malaria cases more than half a century. Out of these, 30 deaths were among tourists who brought the parasites from Africa. In 1978, there were nine malaria deaths in the United Kingdom. These were treated by physicians as influenza, not suspecting malaria. Sometimes, the human malaria parasite, plasmodium can lie dormant in a human body lodged in the host's liver for years and then surface again. When these take refuge in the body glands, no amount of quinine can destroy them.

The vectors or carriers in all those cases are either mosquitoes, black flies or snails. Experiments have been conducted successfully to prove that environmental measures can prevent these diseases by destroying the vector habitats and in turn controlling the vectors.

The methods are often simple. In the USA, the Tennessee Valley Authority has shown that by altering the levels of the dam reservoir, it destroyed the habitats of mosquitoes. Similar fluctuation in the water level also proved helpful to, destroy the snails.

The side effects of irrigation activities is well demonstrated in Sudan's Blue Nile irrigation project covering a productive area of 2.3 million acres and over 313,200 cubic metres of irrigation canals. The Blue Nile Health Project, started in 1979 by WHO would cost US $ 155 million in 21 years to eliminate the environmental and health side effects of the irrigation projects.

UNEP experts, and those from FAO and WHO have launched an integrated programme with the acronym of PEEM (Panel of Experts on Environmental Management of Vector Control) in which environmental management of habitats and the major projects with appropriate health measures would try to eliminate the obvious side effects of the development projects implemented in various countries and provide guidelines to avoid similar situations.

The job of environmental control of vector diseases is not an easy one. It needs research, constant monitoring and experiments. For example, the black flies which cause river blindness are prevalent in Africa in the areas where beautiful streams and cascading waters could be tourist attractions.

It has been found that by impoundment of water and wave agitation the habitats of these flies could be destroyed. On the other hand impounded water could be the habitat for mosquito breeding which brings malaria. Irrigation canals out of the impounded reservoirs could be the habitats of bilharzia (schistosomiasis) snails.

Economic models of the environmental management to control diseases have shown that it pays in the long run. What is the use of an irrigation project where the farmers spend all their earnings on health bills? It has been proved beneficial for land and water management disease control and has led to better agricultural production as a healthy farmer can produce more than a sick one.

The figures for vector disease sickness are very high starting with more than 200 million people affected by schistosomiasis which is nearly a health hazard to 600 million people in 72 countries in Asia, Africa, Latin America and the Caribbeans.

Formerly, about seven out of ten people in the world were exposed to malaria risk. Today only four out of these seven are exposed to that risk. Yet that is a very high risk in terms of population figures.

River blindness is more common to Africa and the number of people affected by this in central Africa is also very high.

Filariasis which causes swollen feet and can lead to elephantiasis is another disease which is common to Asia, Africa and Latin America.

Experts believe that vector control and environmental management of the habitats could eliminate these diseases when supported with health programmes and controlled use of chemicals. Similarly trypanosomiasis (sleeping sickness) caused by tsetse flies can also be environmentally controlled with chemicals.

All these environmental measures have to be carried out carefully as experience shows that any hasty measures without proper planning have always led to major complications. For example, the destruction of mangrove forests in Indonesia brought back malaria as anopheles mosquitoes breed well in sunlight. When the forest was replanted malaria incidence dropped sharply.

A complete econometric study of the cost-benefits of the environmental control of vector diseases is yet to be made because of its complexity. But experts agree that the total benefits to the people through this in terms of health improvement, agriculture production and livestock breeding far surpasses the cost of inputs and efforts.

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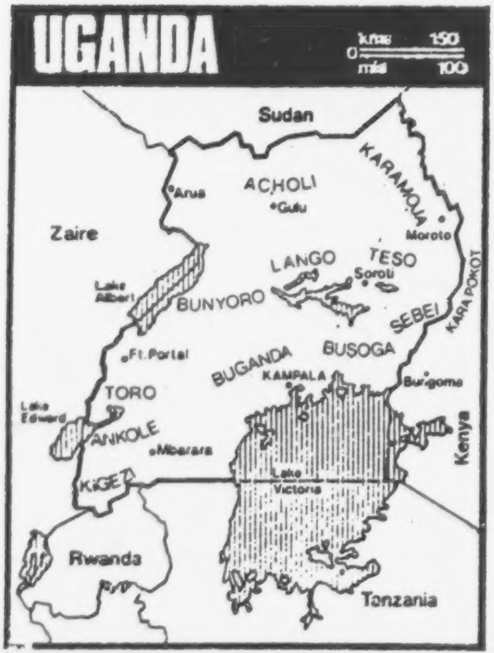
Medical teams scattered in all directions



Cholera is now out of control and spreading into Kenya

THE STANDARD 11.6.80 p4

By LEO ODERA OMOLO

ABOUT 300 people are dying each week of cholera and hunger in the north and eastern regions of Uganda. The disease is out of control because the acute shortage of medical personnel and drugs.

Cholera first hit the two regions last August. It started in the semi-arid land of the nomad tribe known as Karamojong in the Karamoja District in the north-eastern province.

The government of the now ousted President Godfrey Binaisa sent teams of health officials and medical experts with drugs for vaccination campaigns. But they found working conditions unbearable. There was no security protection for themselves, their vehicles and their drugs. They were short of transport, food and water. Armed bands of cattle rustlers fired on the teams, robbing them at will.

Cattle rustling among the nomad tribes, especially among the Karamojong and Kara-Pokot, is traditional, but now it has become almost like a f[illegible] war. People, armed with sophisticated automatic weapons they had acquired from the defeated soldiers of Idi Amin, raid villages and drive cattle towards the Uganda-Sudanese borders.

Still unconfirmed reports say soldiers of deposed President Amin, now living in refugee camps in the Southern Sudan not far from the border, have been involved in the raids.

The medical teams panicked and scattered in all directions, leaving hundreds of cholera victims unattended to. Hospitals, dispensaries and other health centres were closed, except for a few run by missionaries. These also suffered from the drug shortage.

In some villages, [illegible] corpses of cholera victims are rotting for days. Worst hit are the Busoga, Bukedi, Kara-Pokot, Karamoja, Sebei districts in the eastern region and the cholera is spreading northwards and southwards towards Uganda's borders with Kenya.

Now the fear is that the disease is spreading into Kenya. Cases of cholera deaths are being reported in the northern and western Kenya districts. Five people have died in Busia District Hospital, near the border. Cholera is also reported among the nomad Kenyan tribes of Kara-Pokot, Turkana in the far north of the great Rift Valley Province, in Kitale in the Trans-Nzoia district and in Bungoma District.

Because of lack of facilities inside Uganda many people are crossing into Kenya for medical attention. The Kenyan authorities have the situation under control, and teams of experts are watching the entire border areas.

As the new rulers of the military and Presidential Commission squabble with the politicians in Kampala the famine situation in the north-east is growing.

From 600,000 to one million people urgently need food to survive, and unless fresh supplies arrive within weeks many will die.

Harvesting time for cereals and grains will be July-August this year, but because of the security situation, cultivation has been poor. The nomad tribes, unused to mechanised agriculture, mostly rely on oxen-driven ploughs. But the oxen have been driven away in their thousands, along with herds of cattle, to the north by the cattle rustlers.

Most Ugandans in the two regions depend on finger-millet, sorghum millets, maize flour-meal, bananas, cassavas and sweet potatoes as their staple food.

The Government of Binaisa is being accused of having diverted foodstuff and grains sent by international food relief agencies for personal gain. Former Finance Minister, Jack Ssentongo, is said to have amassed wealth through corruption and theft of food and money donated by foreign governments.

Cash meant for the economic reconstruction and rehabilitation of Uganda is said to have gone into personal accounts while people were left to die from hunger.

There is ample evidence that a huge consignment of sugar donated by the Indian government was embezzled and re-exported to neighbouring countries like Zaire, Rwanda, Kenya and Tanzania for money. Most of the food, blankets, drugs and other gifts from international agencies never reached the people they were intended for.

Some of Binaisa's Ministers abandoned their homes and took refuge in the Kampala International Hotel, living lavishly.

Army men were also angry when Binaisa released from detention Amin's top aides, including members of the notorious State Research Bureau. After release some joined other groups of bandits and anarchists in Kampala.

Another complication was that the UNLF Government had failed to disarm those soldiers who opted to leave the army after the liberation.

— GEMINI

(e) Students then present their critiques to the class. The best critiques may be rewritten in an acceptable form and displayed to motivate the others or included in the school or college review magazine.

ACTIVITY III

TOPIC : To assess the impact of socio-cultural change in an area

Concept : Population

Objectives : Students should be able:

1. to state the 'push' and 'pull' factors of migration;
2. to predict the effect of a specified change in patterns of agriculture of an area;
3. to form judgements as to which types of action are desirable environmentally and lead to a happy society.

Materials : Printed copies of the environmental problem.

Procedure :

(a) Students are given the environmental problem and asked to discuss it.

Lakeside is a rural town on a dirt road, twenty kilometers from the main road to the nearest urban industrialized centre of Bakersville. Many young people have left Lakeside to live in Bakersville where some of them have secured jobs in the factories. The older and retired people in Lakeside earn a living by mixed farming or looking after their grandchildren whose parents are working in Bakersville. Sometimes they produce a surplus of food which can be sold to passers-by but it has to be carried to the main road. Most of the food however, is eaten at Lakeside. There is a small shop stocked with tinned products like baked beans, tinned fish, soups, cheese and other items not produced in Lakeside. The shop also sells paraffin for lamps. For health care and secondary school, people must travel to Bakersville.

There is now a project to develop in Lakeside in the form of fruit farming especially the cultivation of pineapples (can select suitable crops) which grow extremely well there and can grow all year. By locating a pineapple factory in Lakeside to produce pineapple juice and tinned pineapple, it is believed that the living standards of the people will rise and that the drift to the urban area of Bakersville will be reduced. The young productive people from Lakeside may actually return to live there.

(b) Students then present their discussion to the group or class.

Discussion Questions :

(i) Through research and discussion, identify the economic gains likely to benefit the people of Lakeside as a result of this development project of pineapple growing (or a suitable alternative).

(ii) Identify the changes which are likely to occur in Lakeside as a result of this development.

(iii) Assess the effect of these changes on the total environment. Select which changes the citizens should accept in Lakeside so that the 'balance in nature' is maintained.

This type of activity which involves practice in the analysis of situations enables students to identify significant variables (values, opinions, objects) which are interacting to create a situation. If properly managed it can lead to the establishment of priorities that enhance the environment and effect development.

ACTIVITY IV

TOPIC : Cemetry Population Study

Concept : Population changes affect individuals, their environment and society

Objectives : Students should be able:

1. to record and compute data;
2. to draw and analyse graphs;
3. to explain how population changes affect individuals, their environment and society.

Materials :

1. a visit to the nearest cemetry;
2. data tables for each student;
3. clipboard, pencil, rulers;
4. chalk for excursion;
5. graph paper.

Procedure :

(a) Students are briefed on the objective of the study and given the data tables as shown below:

Death Rates Within Specified Age Categories:

Age of Death

	0-5	6-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Over 80
1971-1980	NO %									
1961-1970										

(i) Each student is requested to make 10 entries on the sheet (or a number that will give the class 300 pieces of data).

(ii) The students are asked to write down any information concerning the cause of death.

NOTE: Students should not be trained in choosing or not choosing certain tombstones. Mark tombstones with a piece of chalk (X) so that other students do not record the tombstone again.

(b) Students compile data on one master sheet in the classroom. Students add up their totals for each time period for each age range. This is then worked out in percentages again.

(c) The teacher prints and distributes the master sheet.

(d) The students then graph each time period using the age at the time of death as the horizontal axis. (i.e. 0-5, 6-10,etc.) and percent of sample in each category (i.e. 0, 2, 4,etc.) as the vertical axis.

A different colour may be used for each time period to get a striking visual impact (i.e. 1971-1980, 1951-1970, 1951-1960,etc.).

(e) Class discussion of experiences and analysis then follows.

Discussion Questions:

(i) Why do we have to change totals to percentages in our data? (Skills of computation and their use in analysing environmental problems are stressed.)

(ii) Which age group experienced the largest decrease in death? Why?

(iii) How could you explain this decrease in each of the time periods?

(iv) From the information provided, can you detect any significant migration patterns?

(v) From the information provided, can you make any inferences concerning the effect of people on their surroundings and society in general?

(vi) Is the information from this cemetry representative of the population of the area?

(vii) Where should cemetries be located and why? Funeral and burial customs vary with the different cultures.

ACTIVITY V

TOPIC : Analysis of the age - sex structure of a population and its effects on the environment through the demands set by the people.

Concept : Population

Objectives : The students should be able:

1. to compute data;
2. to draw and analyse population pyramids;
3. to draw conclusions from available data;
4. to note the effects such population characteristic have on the available resources;
5. to suggest possible solutions to problems.

Materials :

1. The latest population data of your country 'A' and one other country 'B' at a different level of development.
2. Graph paper.
3. Pencil, rubber, ruler.
4. Population pyramids of different types to illustrate the shapes that indicate the nature of youthful, mature and old populations (transparencies of chalkboard drawing).
5. Overhead projector.

Procedure :

(a) Distribute the data for country 'A' and country 'B' to the students.

(b) Students draw population pyramids for each country using a suitable scale. Age cohorts should be 5 years.

(c) Students label their pyramids appropriately. (Need to include heading, scale, male, female, dependents and work force.)

(d) Students calculate the dependency ratio for each country.

(e) Class discussion is then organized to highlight the major issues involved.

Discussion Questions:

(i) Describe the shapes of the population pyramids and account for the differences in age-sex structure of the population of country 'A' and 'B'.

(ii) Why is the dependency ratio different between population 'A' and 'B'?

(iii) What are the implications of the dependency ratio in each country? (Bring out the differences in developing societies and their effects on the available resources. For example in developing societies more people demand more jobs, more food, more shelter, more schools; this leads to greater pressure in land and conflict between different types of land use. Poverty is the main cause of environmental degradation in the third world, fewer youth, closure of schools, need to orient development to care for the older people in terms of recreational, medical facilities.)

(iv) What possible reactions do you have to these problems?

ACTIVITY VI

TOPIC : Investigation of changes in food production and preparation

Concept : Increasing human populations, rising levels of living and the resultant demands for greater industrial and agricultural productivity promotes increasing environmental contamination.

Objectives : To investigate changes in food production and preparation.

Materials :

1. Resource personnel in food merchandising or animal science.
2. Tape records/tapes.
3. Pencil and paper.

Procedure :

(a) Students are divided into groups and asked to collect information about one of the recent developments in food production and preparation which they identify. These should include the following:

- (i) Tremendous growth in use of frozen foods e.g. (meats).
- (ii) Boil-in-the bag items (e.g. tea).
- (iii) Freeze-dried fruits (e.g. vegetables), etc.
- (iv) Packaged foods such as snacks which require no preparation (e.g. crips).
- (v) Single portion products.

Major changes in production patterns include:

- (i) Enormous chicken farm where thousands are raised under artificial light.
- (ii) Tremendous feed-lots where beef cattle are fattened for the market.
- (iii) Use of antibiotics in animal feed.
- (iv) Use of hormones to stimulate animal growth.

Students may collect information from the library, through field study and/or interview.

(b) Students record their information on tapes (if interviews are conducted).

(c) Students analyse their information to see what effects these changes in food production and preparation have on:

- the individual;
- the society;
- their effects on the environment.

(d) Group presentation and discussion.

Discussion Questions:

(i) Has the development reduced the cost of food? Is it now available to the majority?

NOTES: Hunger and famine afflict a large part of the human environment with accompanying environmental degradation.

(ii) Has it improved food quality? Who, if, anyone has been harmed? (Consider food additives, use of chemicals, etc.)

(iii) Who has benefited from the development? What has been the effect on energy demands?

(iv) Have any of the developments changed the lifestyles of individuals? Families? Societies?

(v) Is the development likely to continue or accelerate in the years ahead? Why or why not?

(vi) What are the environmental impacts of such development?

ACTIVITY VII

TOPIC : Building structures are used to interpret the cultural history of the area around the school or college.

Concept : The culture of a group is its learned behaviour in the form of customs, habits, attitudes, institutions and lifeways that are transmitted to its progeny.

Objectives : The students should be able:

1. to make an inventory of the building structures within the school or college vicinity;
2. to locate the buildings on a map of the area;
3. to develop a classification for types and age of building;
4. to make an inventory of the fences in the area;
5. to determine to what extent environmental and/or social-economic considerations were responsible for shaping the settlement pattern and cultural history of the area.

Materials :

1. Map of the area
2. Pencil and paper
3. Camera and film
4. Models of building types
5. Town planner - resource person.

Procedure :

(a) Students are divided into groups and given specific tasks:

(i) Inventory building structures within the vicinity of the school or college. Locate these buildings on the map.

(ii) Photograph the most common types of buildings.

(iii) Make models of the most common types of buildings (paper, or cardboard or papier maché).

(iv) Develop a classification system for types of buildings (e.g. shape, roof shape and type, materials used in construction etc.).

(v) Develop a classification for age of buildings (pre-World War I, between the wars, post-World War II, etc.).

(vi) Map the vacant buildings in the area and determine how long they have been out of use. Try to find out original use and the factors that caused the building to become vacant.

(vii) Make an inventory of fences in the area. What material was used to build them? What types of fence are they? Do they serve any purpose?

(b) Students collect the information, prepare their reports and models and photographs which are displayed for class presentation and discussion.

Discussion Questions:

(i) What cultural traits emerge from the types of building structures studied?

(ii) What environmental and socio-cultural factors influenced the types of buildings?

(iii) Can shifts in population be observed?

(iv) What factors are affecting growth in the area?

(v) How are traffic patterns affecting the area?

NOTE: Demand for land, congestion, noise, pollution etc.

(c) Followed up later by a talk from the town planner.

ACTIVITY VIII

TOPIC : The water budget of an area and its implications for land use policy.

Concept : Conservation and management of natural resources.

Objectives : Students should be able to:

1. visit a small watershed;
2. collect precipitation (P) and evaporation (E) data for representative towns in the watershed and analyse water budget of area;

3. find out the future plans for land in the watershed;
4. present their ideas on how the watershed could best be developed for future use.

Materials :

1. Visit to a small watershed near school/college.
2. Statistics of the precipitation and evaporation of representative towns in the area.
3. Map of the watershed.
4. Resource personnel e.g. town planner, water development officer and/or municipal officials.
5. Pencil, graph paper.
6. Camera and film.

Procedure :

(a) Students visit a small watershed nearby the school. They map out the present use of the watershed.

(b) In class, students are given the water budget data for 2 representative towns in the watershed in millimeters (mm).

Water Budget Data for Town X

Months	J	F	M	A	M	J	J	A	S	O	N	D
P mm	88	70	96	155	189	29	17	20	34	64	189	155
E mm	155	163	168	126	97	90	82	88	119	154	127	133

Water Budget Data for Town Y

Months	J	F	M	A	M	J	J	A	S	O	N	D
P mm	39	28	58	270	138	101	132	182	100	57	87	137
E mm	149	147	159	133	127	110	108	110	127	140	123	137

Students then prepare histograms to show the annual water budget of Towns X and Y.

Suggested scale: H.S., 1 cm represents 1 month
V.S., 1 cm represents 20 millimeters

Label the areas of water surplus and water deficiency on the histograms.

(c) Students calculate the total quantities of water surplus and water deficiency and suggest what measures must be taken to cope with these two different situations and the resulting impact on the environment (i.e. land, plants, animals and humans).

(d) Students contact the resource personnel to ascertain the future plans for the land - the watershed, keeping in mind the water situation.

(e) Students then present their ideas on how the watershed could best be developed for future use. Photographs and models might be used. A local official from the Ministry of Lands and Settlement or a similar institution might be invited to attend the final presentation and display of work and round up the discussion with a few relevant comments.

ACTIVITY IX

TOPIC : Types and causes of conflicts between human beings and wildlife.

Concept : Conservation and management of natural resources.

Objectives : Students should be able to:

1. acquire knowledge about wildlife;
2. create awareness of the value of wildlife;
3. develop an understanding of the need to conserve wildlife and other natural resources;
4. generate situations and take action where necessary;
5. collect and organise information.

Materials :

1. Newspaper report on wildlife problem.
2. Local official letter (e.g. District Commissioner in Kenya) to former, issuing directive.
3. Map of protected areas in the country.
4. Recent report of Wildlife Conservation and Management in your country.
5. Resource person e.g. game warden.
6. Film: UNEP 'The Vanishing Breed' and film projector.
7. Pen and paper.

Procedure :

(a) Students are divided in groups and receive copies of the newspaper cutting and the local official's letter Newspaper Report on Wildlife Problem:

'... it was reported that a herd of buffaloes which had eaten and trampled on a farmer's crops in his farm adjoining the national park caused him much distress ...'.

The local official's letter:

This was issued to a farmer stating:

'... I direct you to clear all the bush around your farm as these are good habitats for wildlife and should be surrended to the park authority. Your compensation ...'.

(b) Students discuss the type and cause of the conflicts between the farmer and wildlife and the local officials as emerges from the given information. They use the map and report on wildlife and protected areas.

(c) Students then suggest alternatives to the local official's letter and view the film: 'The Vanishing Breed'.

(d) Students draw up a plan of action in consultation with the local game warden or ranger and the farmer and discuss it with the local official.

(e) Students take action. They write a letter to the local official drawing his attention to the detrimental effects of his plan of action both to the wildlife and the environment per se and present him with a feasible alternative solution.

ACTIVITY X

TOPIC : The environmental impact of a factory.

Concept : The natural resources are affected by the material welfare of a culture.

Objectives : Students should be able to:

1. examine the impact of a factory first, and
2. acquire skills of data collection and analysis.

Materials :

1. A factory in operation (in this example a sugar factory).
2. Clipboard, pencil and paper.
3. Factory guide.

Procedure :

(a) Students visit a sugar factory (or suitable alternative) and note the following points which should form the basis of discussion in the classroom later:

- (i) List the products produced.
- (ii) The history of the factory which helps to explain its geographic siting.
- (iii) List the materials used in production.
- (iv) Note the main processes included in the production of sugar.
- (v) Note the human resources - number of employees, sex, age structure, length of service.
- (vi) Note the working conditions such as pay, smell, hours of work, fringe benefits, safety aspects etc.
- (vii) Note how the factory deals with disposal of wastes and by-products.
- (viii) Note the relationship of the factory and out-grower.
- (ix) What efforts are made to ensure consumers get a good quality product?
- (x) What environmental problems arise from this type of land use i.e. sugar cane farming and sugar cane processing? Note effects on water quality, plant, animal life etc.

(b) Students collect data, analyse their findings and write a report.

(c) Class discussion on the benefits and risks in this type of economic activity e.g. sugar cane farms now used to meet energy demands. The discussion should stress the recognition of interrelationships and the consequences for society, the particular environment and the environment in general.

ACTIVITY XI

TOPIC : To decide on the location of recreational facilities.

Concept : Natural resources affect and are affected by the material welfare of a culture.

Objectives : Students should be able to decide on the location of selected recreational facilities.

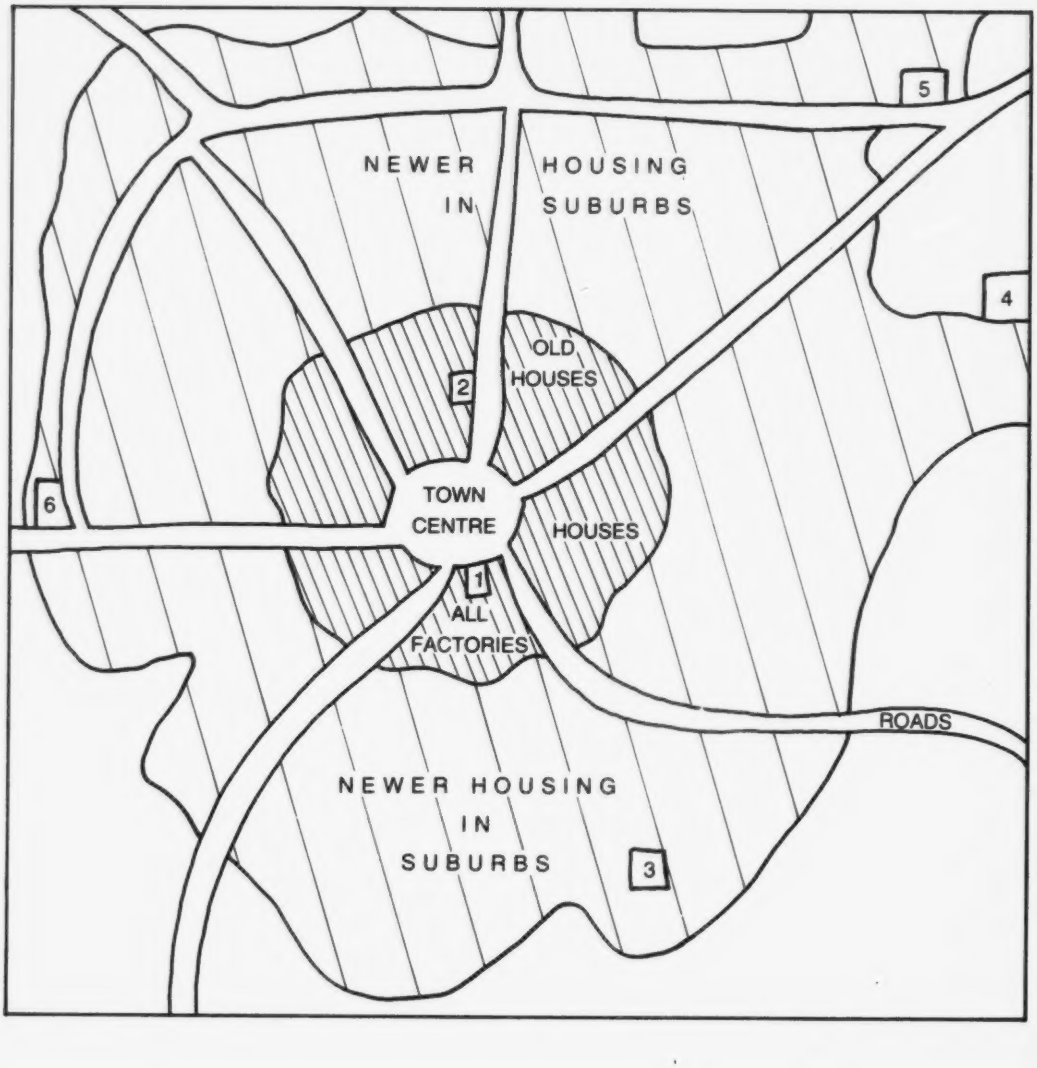
Materials

1. Work sheets with sketch and table.
2. Resource personnel e.g. real estate agent or town planner or mortgage loan official.
3. Chalkboard, chalk.
4. Overhead projector and transparency.

Procedure

(a) Students are briefed about the problem.

At the local council meeting it was decided to build four leisure facilities - a cinema, youth club, football pitch and a cinema in the town. The six sites available are shown on the map. Carefully analysing the map, decide where you would have them built. Give reasons for your choice.



(b) Students study the problem and make their choices giving reasons. They fill in the table below.

Leisure Facility	Site Chosen	Reasons for your Choice
Cinema		
Youth Club		
Football Pitch	6	ideal, away from centre of town, much open space, early accessible
Swimming Pool		

(c) The teacher presente the best solution on the chalkboard or overhead projector then discusses the reasons for each facility. For example, site 6 would be ideal for the football pitch as it is away from the town centre with lot of open space and easily accessible. Students would also have the opportunity to assess their own judgements with those of the rest of the class.

(d) A local official such as the town planner or real estate agent could then be invited to present his views on the siting of these facilities.

ACTIVITY XII

TOPIC : What can be done to conserve energy?

Concept : Conservation of natural resources.

Objectives :

1. To provide students with an entertaining way to become aware of energy consumption patterns.
2. To see what they can do locally to conserve energy.

Materials :

1. Printed sheet entitled 'Energy Bingo'.
2. Film 'We all Need Energy' and film projector.

Procedure :

(a) Duplicate and provide a sheet for each student.

(b) The student mark each block with an X when he actually finds out what is described.

(c) This should be done as an overnight home or school assignment.

(d) The student receives 1-point for each square marked with a 5-point bonus for each complete diagonal, vertical or horizontal row. The student also received a 4-point bonus for completing the inner squares or 4 corner squares (but only 4 points, he cannot get 8 points for both). Total possible points = 110.

(e) After completing the game, a prize may be given to the winner. Then the students can shade the blocks in different colours.

(f) Class discussion on why some save and some waste energy. Stress the need to conserve energy by use of a catchword 'S.O.S.' - 'NOW' - 'Switch Off Something NOW!'.

(g) Followed by film: 'We all Need Energy'.

ENERGY BINGO

Heated room on a warm day	Use of electric fan	Colour TV	Car idling with no driver	Overheated public building (in summer cooled)	Car speeding over 30 km/hr
Door or window open with air conditioning on	Central heating is switched off in hot weather	Lights on in an unoccupied room	Electric toothbrush in use	Open refrigerators in supermarkets	Washing machine using cold water only
Car accelerating smoothly and slowly	Solid state (no tubes) Black & White TV	Dripping hot water faucet	House with no insulation	Lights on at midday in a hallway	Car coming to quick stop (tyres squealing)
Electric dryer in use	Car with only one passenger	Night-time illumination of a public building	Water heater on all day	Bunsen burner burning when not in use e.g. in laboratory	Outside security light burning during the day
Electric blanket in use	Car accelerating rapidly (tyres squealing)	Car with a v-8 engine	Large wattage bulb where a smaller one would do	Electric mixer for small quantities	Self-cleaning oven
Compact car with small 4-cylinder engine	Fluorescent tubes instead of incandescent bulbs	Frost-free refrigerator	TV or radio playing with no one in room	Car easing to a smooth stop	Electric knife in use

ACTIVITY XIII

TOPIC : Dangers that might arise in the use of chemicals in the environment.

Concept : Increasing human populations, rising levels of living and the resultant demands for greater industrial and agricultural activity promotes increasing environmental contamination.

Objectives : The student should be able to:

1. investigate whether the use of a chemical e.g. a herbicide is more effective than hoeing or digging;
2. carry out an experiment;
3. record results from fieldwork activity;
4. interpret results;
5. generate alternatives.

Materials :

1. Any general weedkiller e.g. 'Gramoxene'
2. Watering can, hoe or fork.

Procedure :

(a) Students select an area of ground containing similar populations of weeds.

(b) They mark off the area into roughly three equal portions preferably in squares.

(c) Students count the number of weeds in each portion.

(d) Students are then briefed on how to use the chemical and treat each patch with the chemical as follows:

- Patch 1 Apply the chemical (weedkiller) according to the instructions given. (The mixture has already been prepared for the students.)
- Patch 2 Students hoe or dig the weeds, removing as much as of each plant as is possible.
- Patch 3 Students leave untreated.

(e) Students record the weed population after one week, one month, one term.

(f) In class, they analyse their results and noting the benefits and risks in the use of chemicals. This can be followed up by library research. The concern of many in the use of such chemicals on our bodies and in the environment is highlighted.

PRECAUTION : This has to be brought to the attention of all students prior to carrying out the experiment:

- Avoid splashing the chemical on your skin and clothes.
- Always use gloves and other protective clothing if available.
- Wash your hands thoroughly after using the chemical e.g. Gramoxene.
- Only the area being treated should be sprayed; that is, do not allow the herbicide to splash to areas next to the area under treatment.

ACTIVITY XIV

TOPIC : Environmental pollution caused by human activities.

Concept : The culture of a group is its learned behaviour in the form of customs, habits, attitudes, institutions and lifestyles that are transmitted to the next generation.

Objectives : Students should be able to:

1. express their personal attitudes and values towards environmental pollution through creative art forms. (Can always select another suitable alternative.)
2. develop their artistic activities to express environmental crises with greater impact.

Materials :

1. Art material.
2. Bags for collection.
3. Possibilities for quick field visits to areas where environmental pollution is evident.

Procedure :

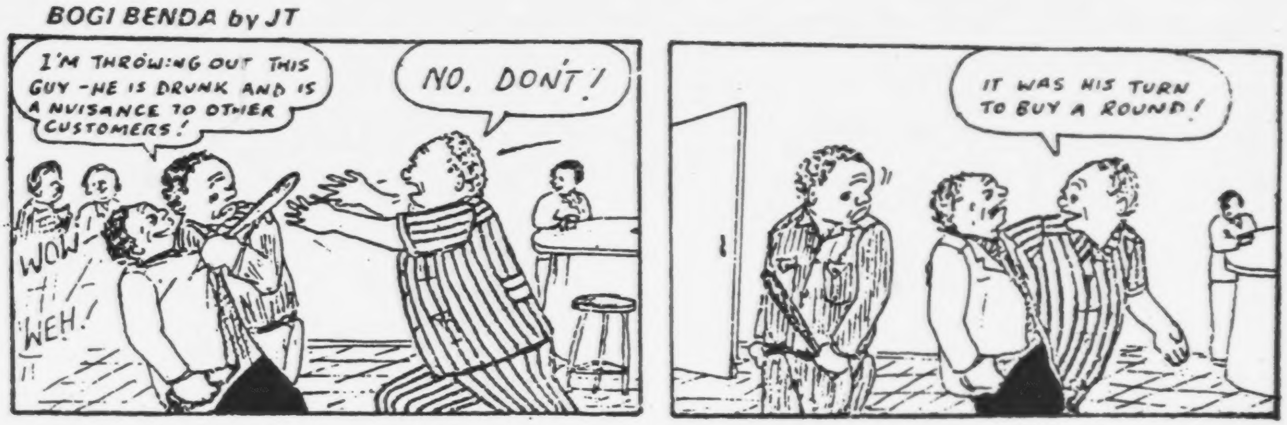
(a) Students visit a scene of actual environmental pollution.

(b) At the site of pollution students collect garbage or symbols of pollution and label them.

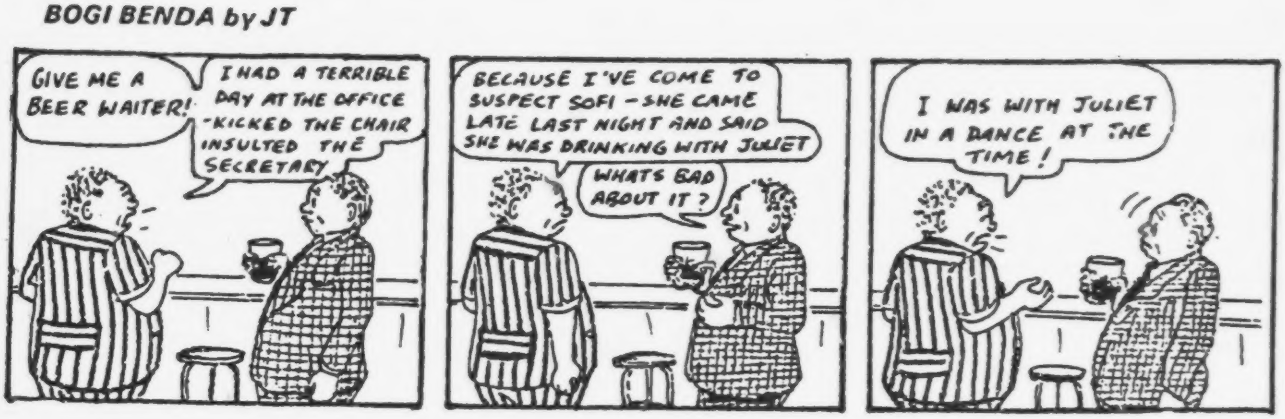
(c) In class, the students select their theme and the art form desired. This may include posters, sketches, cartoons, collages, models, sculptures, creative poems or songs.

Refer to page 98, which includes a selection of cartoons focusing on social problems. Some of the collected items may also be used in the actual making of the art form.

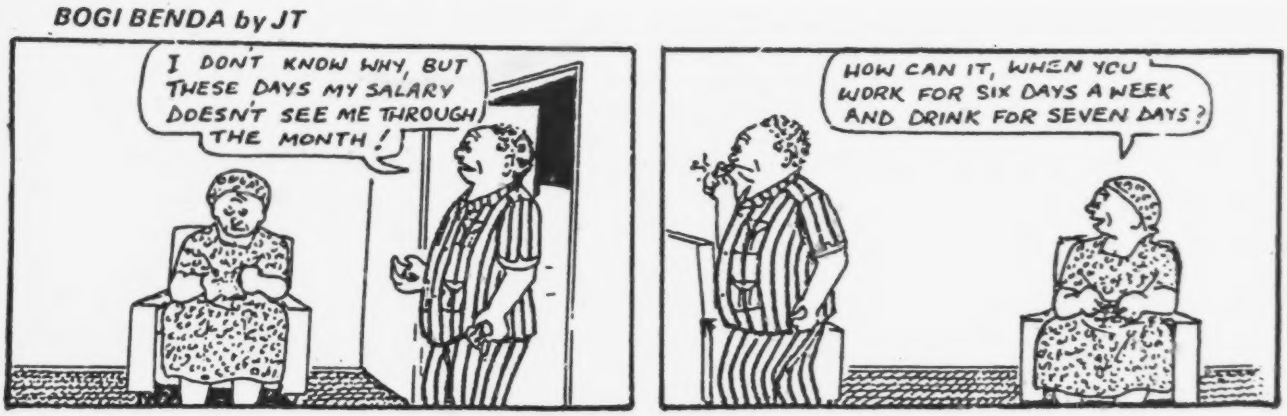
CARTOONS ILLUSTRATING SOME PROBLEMS IN THE SOCIAL-CULTURAL ENVIRONMENT


BOGI BENDA by JT
I'M THROWING OUT THIS GUY - HE IS DRUNK AND IS A NUISANCE TO OTHER CUSTOMERS!
NO. DON'T!
WOW
WEH!
IT WAS HIS TURN TO BUY A ROUND!

SOCIAL NUISANCE


BOGI BENDA by JT
GIVE ME A BEER WAITER!
I HAD A TERRIBLE DAY AT THE OFFICE - KICKED THE CHAIR INSULTED THE SECRETARY
BECAUSE I'VE COME TO SUSPECT SOFI - SHE CAME LATE LAST NIGHT AND SAID SHE WAS DRINKING WITH JULIET
WHATS BAD ABOUT IT?
I WAS WITH JULIET IN A DANCE AT THE TIME!

FAMILY PROBLEM: IRRESPONSIBILITY


BOGI BENDA by JT
I DONT KNOW WHY, BUT THESE DAYS MY SALARY DOESN'T SEE ME THROUGH THE MONTH!
HOW CAN IT, WHEN YOU WORK FOR SIX DAYS A WEEK AND DRINK FOR SEVEN DAYS?

PROBLEMS OF FINANCES

(d) The finished art forms are then displayed in an organized way in the school community and the control and prevention of environmental pollution highlighted. Students then suggest types of action. In this way students become more aware of environmental issues, and it is an effective method of stimulating environmental action in the community.

ACTIVITY XV

TOPIC : Using a film to tell a story.

This activity could serve any topic for which the relevant films and/or slides are available. Examples include: Family Planning, Feeding the People of the World, Forest and Water Conservation, Energy Resources and their Environmental Impact, Problems of the Human Environment, Desertification, Family Planning, Pollution.

Concept : Relevant to the topic (e.g. Forest Conservation).

Objectives : Students should be able to:

1. recognize a problem;
2. define a problem;
3. generate alternative solutions.

Materials :

1. Film (20-30 minutes) or slides that depict issues or problems of the environment.
2. Film and/or slide projector.
3. Pencil and paper.

Procedure :

(a) Screen the film (e.g. WWF Film: 'Africa: Forest or Desert?'.

(b) During the screening, students answer questions on film e.g.:

- (i) Note title of film.
- (ii) Identify the problem.
- (iii) Outline its characteristics.
- (iv) Generate solutions to the problems.

(c) General class discussion.

Discussion Questions:

(i) What is the main environmental problem as depicted by the film?

(ii) Does the film suggest other environmental problems than this main one?

(iii) What are the causes of these problems?

(iv) Would the solutions you have listed cause other problems?

(v) Would people be willing to solve these problems if it meant giving up some of their comforts?

NOTE: Students could follow-up by planning to produce a suitable film to highlight an environmental crise within the community in conjunction with the local film production unit for educational purposes. A suitable challenge for secondary school social science teachers and supervisors.

Chapter 6

EVALUATION IN ENVIRONMENTAL EDUCATION

The success or failure of any environmental education programme depends on continual on-going evaluation, carefully planned and implemented. Today, environmental education programmes are directed towards the development of attitudes, values, skills and knowledge in the area of environmental decision-making and problem-solving, (Bennett, 1977). The affective, cognitive and skill goals and objectives of environmental education must be translated into behavioural terms before any kind of meaningful evaluation can be attempted. For '... in the final analysis, the success of environmental education will be measured in terms of its ability to change the behaviour of society', to enhance the quality of life, (Ames, 1969).

Evaluation is needed so as to know what to improve, and how to improve it. First, there is need to improve the learning activities: that is, to develop and strengthen environmental education programmes necessary for achieving the maximum contribution of environmental education to the school's educational goals. To do this, the courses planned must be soundly constructed, effectively taught, properly sequenced and carefully evaluated to meet the needs and interests of the students and society.

It must be stressed that environmental education is a new dimension in the curriculum. It must be inter-disciplinary as it is concerned with the total human ecosystem. Its strength lies in the linking of all parts of the curriculum because it brings a knowledge, understanding and perspective to the relationship between the many specialized arts and sciences and contributes to an understanding of the whole. It should help individuals through the acquisition of knowledge and skills in many disciplines to investigate the environment and help resolve environmental problems. The curriculum design must be flexible and easily adaptable to change.

The evaluative procedures selected for the different components of the curriculum and under different conditions of implementation must be flexible and responsive to the changing emphasis on program objectives as well as to the great variety of educational institutions, (Bakshi and Neveh, 1980).

Curriculum evaluation must be both formative and summative in nature. It must focus on the consistency of all elements and their interrelationships. For example, a pertinent question to ask when determining whether the curriculum has internal consistency is: 'Are goals, objective, instructional procedures and student evaluation strategies consistent with each other?', (Hungerford and Peyton, 1980).

EXAMPLE OF A QUESTIONNAIRE EVALUATING THE COURSE CONTENT OF AN EE PROGRAMME

Course: Term:

Instructor: Date:

Course evaluation:

Each of the following statements describes an important component of the course work.

Answer each question in the parentheses to the right by choosing one appropriate number from the following scale:

Strongly Agree = 5
Agree = 4
Neutral = 3
Disagree = 2
Strongly Disagree = 1

1. The objectives of the EE course were clear: ( )
2. The course was taught at a level too difficult for the class: ( )
3. The reading assignments and the learning activities were appropriate to the course: ( )
4. The instructional strategies were varied, well planned and carried out: ( )
5. There was a logical sequence in the EE course activities: ( )
6. The concepts and ideas relating to the environment were clearly developed: ( )
7. The class time was appropriately spent: ( )
8. The time spent on field activities in EE was useful: ( )
9. The procedures for evaluating student performance were made clear early in the course: ( )
10. Evaluation procedures are appropriate to the EE course objectives: ( )
11. The objectives of the course were realized: ( )

If you have further written comments about the course which have not been expressed in your answers, write them on an attached sheet.

Secondly, evaluation is needed to improve students' performance or student outcomes. There is a need to determine to what degree the students are acquiring the behaviour consistent with EE curriculum goals and objectives. For example, sensitivity to changes in the environment particularly those caused by human intervention, the values and attitudes of social justice and human consideration in all activities and the manifestation of conservation behaviours.

In evaluation of cognitive outcomes, there is need to test knowledge and understanding of environmental issues and the acquisition and transfer of knowledge. The latter is most likely to occur when students have experience with a diversity of environmental problems, can distinguish relevant from irrelevant facts and can use their knowledge in variety of situations.

In the skills domain, there is need to evaluate the investigatory, problem-identification and problem-solving abilities in reaching solutions on urgent environmental issues. The following critical thinking skills should be encouraged. The abilities to identify central issues, to recognize underlying assumptions, to evaluate evidence of authority. The latter may involve the recognition of bias and emotional factors, stereotypes and cliches, distinguishing between the essential and the incidental and determining whether facts support a generalization. Finally, be able to draw warranted conclusions, (Berg, 1965).

As the environmental education learning process emphasizes first hand experiences focusing on the immediate environment of the student, that is, the school site and the community and the total environment, there is need to stress not only the thinking and behaviour skills but the attitudinal feelings, associated values and concepts, so important in the process. The affective outcomes are essential but more difficult to determine.

Needs motivate an individual to adopt certain attitudes which in turn satisfy basic needs through selective types of behaviour. Attitudes cluster to form values. There is need to deal with values which is increasingly becoming an accepted area of environmental education practice. A value may be defined '... as a result of activation of both the affective and cognitive domains and seems to be one of the few connecting links that have been carefully delineated', (Raths et al., 1966).

Values motivate and guide people's action or direct behaviour. Environmental education in its nature is closely associated with values education as several educators in environmental education have pointed out that, '... the root cause of the environmental crisis is not population growth, industrial growth nor our economic or political systems but attitudes and values which motivate human decisions', (Swam and Stapp, 1974). Behaviour can be made to occur by external conditions. Attitudes cause behaviour and the latter can cause attitudes. There is need to develop evaluative techniques to determine the current state of attitudes and values towards environmental issues as well as the success of environmental education programmes.

EXAMPLES:

1. Test of knowledge of subject matter

The danger of temperature inversion over a heavily industrialized city is:

(a) creation of the 'greenhouse' effect in the air;

(b) increased concentration of pollutants in the air;

(c) increasing visibility and temperature;

(d) decreasing visibility and temperature.

Type of evaluation instrument - used is the written – response instrument of the forced choice objective test i.e. the multiple choice type. This is the most versatile. The choices can be given in single words, phrases, sentences or in pictures. It can test the knowledge of subject matter, methodologies of a discipline or the cognitive style adopted during learning. It calls for more analysis of the question to answer it correctly and less recall. It is easy to mark and grade.

2. Essay test item

Discuss in about 300 words your assessment of the Tree Planting Project and its effect on the participants and the locality in general.

Type of evaluation instrument used is free-expression type where the respondent freely expresses his opinions and reactions to a situation, object or event. The weak point is the subjectivity of the rating responses.

3. Checklist for descriptions of likes

Check the activities you would like to be involved in:

_________ 1. dancing

_________ 2. singing

_________ 3. tennis

_________ 4. soccer

_________ 5. fencing

_________ 6. debating

Type of evaluation instrument used is a checklist where the respondent checks off the items that he likes or dislikes, or recommends or rejects, or possesses or not. It can include a list of behaviours, situations, descriptions or feelings, activities etc.

4. Sample rating scale items

Indicate how you feel about the statement or phrase by putting a circle around the number that expresses it.

Field study as a school activity:

1	2	3	4	5
Like very much	like sometimes	undecided	dislike sometimes	dislike very much

New industries that will pollute the environment should NOT be allowed to open:

1	2	3	4	5
Strongly agree	agree	neutral	disagree	strongly disagree

The effects of human activities on the environment as a topic for inclusion in your social science class:

1	2	3	4	5
Very interesting	interesting	undecided	not interesting	not very interesting

Type of evaluation instrument is the rating scale. It enables students to express degrees of feeling between opposite poles. Fairly easy to construct and are easy to check.

The teacher may also note down brief notes on the behaviour of a student or incidents involving the student. This is done unobtrusively i.e. the individual observed is unaware that he or she is being evaluated. This anecdotal record is used to reveal aspects of the student's personality, values, capability and skills observed in a natural setting.

Another instrument is the self-report. On the request of the evaluator, the student records the times, occasions, and other relevant data of participation in group action on an environmental problem. Here the entries are made by the individual.

At times oral responses in an interview are useful as emphasis is given to spontaneity and facial and behavioural reactions to the questions.

Teachers occupy a research and developmental role in environmental education programmes. Teachers should participate effectively in material development both in selecting the area for work and in determining the kind of approach to be made in it. There is need to evaluate the teacher's abilities to plan for the teaching, to teach in and out of the classroom, to evaluate the teaching and re-direct efforts if necessary, to control the class and to assess personal characteristics such as the mode of dress and alertness. The overall performance of the teacher in the school may be evaluated by the preparation of teacher effectiveness scales spread from zero to five on the above mentioned aspects of teacher effectiveness. This could then be completed by the teacher as part of self-evaluation, the Principal or Headteacher, and/or an observer in the actual class. (Refer to the given example.)

EXAMPLE OF A QUESTIONNAIRE EVALUATING INSTRUCTOR

Course: Term:

Instructor: Date:

Answer each question in the parentheses to the right by choosing one appropriate number from the following scale:

Strongly Agree = 5

Agree = 4

Neutral = 3

Disagree = 2

Strongly Disagree = 1

Instructor evaluation

Each of these statements describes a basic component of teaching. Give the instructor an overall rating for each component. Use the scale presented above for your answers.

1. Has command of the subject matter: ( )
2. Expresses himself clearly, states objectives, summarizes major points, and provides emphasis: ( )
3. Is sensitive to the response of the class, encourages student participation and welcomes questions and discussion: ( )
4. Is readily available and friendly toward students: ( )
5. Enjoys teaching, is enthusiastic about the subject and has self-confidence: ( )
6. Makes the course exciting: ( )
7. Has increased my appreciation of the subject: ( )
8. Related class topics to current developments, to other areas of knowledge and to student's lives and experience: ( )
9. Gives interesting and stimulating assignments: ( )
10. Gives tests that require creative original thinking and/or have instructional value: ( )

If you have further written comments about the instructor which have not been expressed in your answers above, write them on an attached sheet.

There is a need to carefully prepare and state objectives and goals clearly. There are standards or criteria which determine in which direction and to what degree needs are met. Goals are the more idealistic expectations giving an overall direction to the programme. Objectives establish more specific levels of achievement leading to the attainment of goals. The evaluation mode or strategy will depend entirely on the way in which the objectives have been stated. The evaluative instrument will measure what the objectives specify as appropriate human behaviour following instruction. An attempt should be made as far as possible to direct evaluative techniques towards measuring behaviours as it is easier to evaluate achievement of behaviourally stated objectives, (Eiss and Marbech, 1969).

For example, for a single lesson on 'The Social Elements in my School Environment' the specific measurable objectives might read as follows: students should be able to:

1. identify the social groups in the school environment;

2. give examples of their interaction;

3. assess the impact of each group interaction on the total school environment.

Evaluation of the acquisition of objectives is based on some form of measurement, an integral part of evaluation. Measurement is the systematic and formal process of gathering data or information and is used to determine the degree to which the students reflect the particular desired behaviours or characteristics. The data collection mechanisms of observation, self-reporting and questionnaires constitute the measurement phase of evaluation used to assess the worth of an environmental education programme. On this data, judgements or decisions about the effectiveness of instruction in achieving its goals are made. It concerns the value of the environmental education programme and the extent to which it meets identified needs.

Evaluation is to a great extent a value judgement based on the extent to which certain objectives have been met and the relation of these objectives to one or more curricular goals, (Bennett, 1979).

The evaluation techniques available to the educator must be logical in development, easy to administer and subject to straight forward analysis to be effective. The techniques must also be reliable, valid and appropriate to the task at hand.

Reliability refers to how consistently the measurement techniques measure the variable in the same way. For example, the standardizations in evaluation procedures in pre - and post-test applications.

Validity refers to the degree to which the measurement techniques actually measure the variable being evaluated: validity may be internal: that is, how well it measures what it purports to measure. Or it may be external; that is, how generalizable the results are.

There are three types of evaluation techniques, process evaluation, formal and informal evaluation.

Process evaluation involves the observation and evaluation of students during the learning process. There is need to observe the kinds of behaviour that give evidence that the learner has acquired the desired feelings, concepts and skills and to consciously look for their occurrence during the learning process. This can take many forms and the most suitable has to be determined in each case, (Bakshi and Naveh, 1980). Students have to be provided with opportunities to evaluate the programme throughout its duration in the form of continuous assessment and conclusion (final examination or end of term test).

Formal evaluation involves primarily pencil-paper instruments for pre-testing and post-testing. The use of standardised tests has the advantage of providing objective and overall measure of success or failure. There is a need to design and develop relevant tests that can be used to judge the effectiveness of various components of the environmental education programme. Evaluation instruments can include checklists, or inventories, subjective essay question multiple-choice objective questions and attitude scales. These may be differential, summative or cumulative. The most common methods of constructing scales for affective outcomes are the Thurstone and the Likert-type scales. These methods depend upon the participants signifying their agreement or disagreement with a series of statements about the object or concept towards which their attitude is being assessed. Refer to examples given in the earlier part of the chapter.

Informal testing is best suitable for judging the success or failure of a programme where it is important to focus on specific features that arise in particular contexts. It is more flexible and adaptable to specific needs and can be adapted to a specific target population.

Attitude and behaviour can also be measured by unobtrusive measures. These are techniques of data gathering during which the students are unaware of being observed and evaluated. The observations of actual change of behaviour by students are done by noting their behaviour in accepting responsibilities, initiating activities and communicating with administrators. For example, the anecdotal record. Other unobtrusive approaches include the use of games, discussions, school newsletters, bulletin boards, posters, the circulation of library books and optional assignments such as project work. On the latter, the teacher acts as an important resource and encourages students to work on their own as much as possible considering their effort and persistence.

Evaluation techniques for environmental education need to be innovative. They should emphasize processes rather than content and basic concepts and skills rather than facts.

Continuous evaluation of environmental education programmes is the most desirable as these are designed to help students continuously to improve their skills and abilities. It makes for greater reliability because the judgement of students work is based on a number of samples instead of a single paper or exercise. It motivates the student to perform better as there is time for improvement as a result of discussion and experience. Furthermore anxiety is less when the marks are accumulated gradually. Hopefully, the students will continue to seek to improve their behaviour and in the process set higher standards with reference to the use or enjoyment of the environment. Occasionally, it is suggested that the students be involved in the appraisal of their own work so that they appreciate the errors and limitations but also see new possibilities.

Once the results of evaluation are got, they should be described in ways that are both convenient and meaningful. Use may be made of the range and mean values or the histogram for visual presentation, or the standardization of marks where the need is felt to compare different classes on a common scale.

Evaluation must be accompanied by on-going research. This is needed to develop sample concept test items and also suggest how different approaches affect the learner and how effective they are in the teaching of environmental concepts.

To conclude, environmental education programmes need to be continually re-appraised so that revisions can be undertaken promptly and with careful planning for both current and future environmental education programmes, plans and projects. By providing insights into the process of environmental education, evaluation can be a force in the improvement of environmental quality.

Chapter 7

STRATEGIES FOR PLANNING, DEVELOPMENT, IMPLEMENTATION, MANAGEMENT AND EVALUATION OF THE ENVIRONMENTAL DIMENSION OF SECONDARY SCHOOL SOCIAL SCIENCE CURRICULUM

EE is rapidly being recognised as an essential component of the school in achieving social effectiveness and environmentally sustainable development. Hence the need for its inclusion in the school curriculum. Refer to the model for curriculum. This can be effected by incorporation of EE in schools if subject matter in the traditional subjects is re-oriented through:

1. Introduction of new subjects

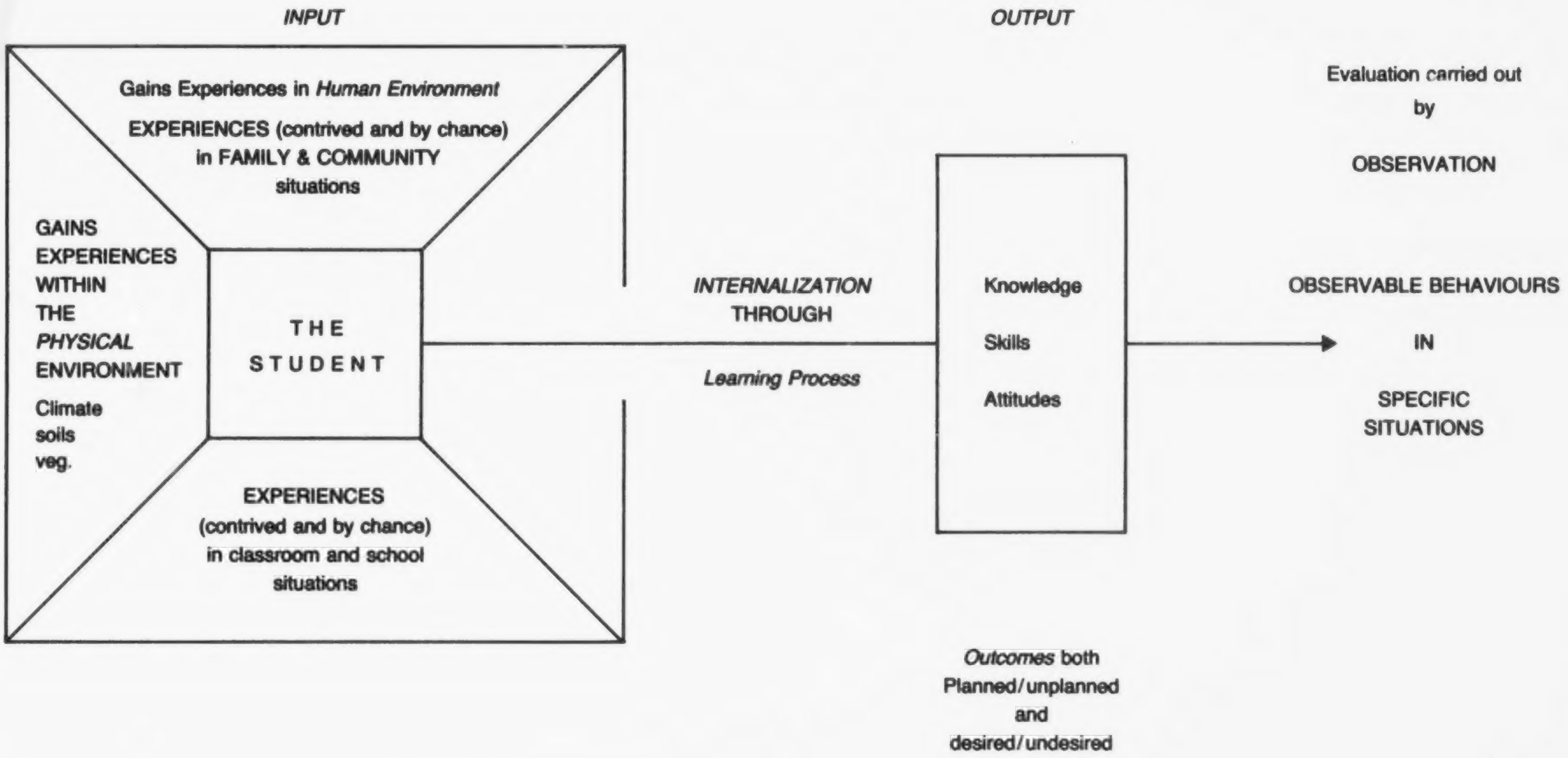
2. Better use of subjects already in the syllabus

3. Re-appraisal or restructure of whole content of different subjects

Some schools will be able to re-orient the whole of the social science curriculum while others, with better human and financial resources, will be able to re-appraise and restructure the whole school curriculum so that it will be environmentally based. This will be done through either affinity or by preparing interdisciplinary units based on environmental issues. Whichever is the case, curriculum developers will necessarily need to appraise and figure out how to take maximum advantage of the environmental dimension of existing secondary school social science curriculum.

Social science is the study of man in society done through the subjects of History, Geography, Literature, Arts, Civics, Music, Economics. These subjects have, over the ages, touched on some environmental component, without calling it so. Each subject tackled what was relevant such as population, human settlements, food, water, disease, mortality, morbidity, illiteracy, unemployment, degradation and depletion of resources and many others. Since social science, like EE strives for social effectiveness and national development, it then becomes clear that social science has a lot to contribute to EE. All that is needed is proper planning to facilitate development, implementation, management and evaluation of the environment dimension already within the social science curriculum. It may, however, be necessary to have additions from other disciplines such as the natural sciences as in the study of ecology and ecosystems which is essential in understanding the environment in its totality. Recently, social sciences in many countries have adopted an integrated approach, a measure that has proved very useful to EE in the process of infusing the environmental dimension into the secondary school social science subjects. To be effective, as a basis for learning for life, the environmental dimension in the social science curriculum must be looked at from the point of view of the whole national environment programme. It must be a continuation from primary education. It must also lay the basis for further and deeper studies in A-level and college level. It must also be relevant to the background of the student i.e. relate to actual environment and real issues which he will be likely to face in real life, as well as exposing him to some regional and international issues like the population explosion. This should all be done within the constraints of age, level, cultural, economics, political and financial background.

Every country or educationally autonomous state should have an effective co-ordinating machinery between schools and institutions involved in EE to ensure they all pool and effectively use their resources, materials, technology, ideas, efforts. It will also make sure that all schools within one jurisdiction are following clearly defined aims and objectives.


INPUT
OUTPUT
Gains Experiences in Human Environment
EXPERIENCES (contrived and by chance) in FAMILY & COMMUNITY situations
GAINS EXPERIENCES WITHIN THE PHYSICAL ENVIRONMENT
Climate
soils
veg.
THE STUDENT
EXPERIENCES (contrived and by chance) in classroom and school situations
INTERNALIZATION THROUGH
Learning Process
Knowledge
Skills
Attitudes
Outcomes both Planned/unplanned and desired/undesired
Evaluation carried out by
OBSERVATION
OBSERVABLE BEHAVIOURS
IN
SPECIFIC SITUATIONS

A MODEL FOR CURRICULUM (after Maddock)

The environmentally oriented secondary school social science curriculum should be centrally developed by experts both in the field (classroom) and in the office (administration, the inspectorate, teacher's centres, curriculum development centres). EE panels with members drawn from the social science, physical and biological sciences and art should be set up. Each member should have an input into formulating ways and means of tackling the environmental dimension of the social science curriculum. Well co-ordinated activities should promote exchange of experience and resources among schools. In a way this would minimize the cost which the massive exercise of re-orienting the existing school curriculum involves. The EE dimension in secondary school social science curriculum should be developed in such a way as to facilitate activities within each of the various components of the education process. These are:

1. Objectives
2. Content
3. Methods
4. Teaching materials
5. Training of personnel
6. Research and evaluation

EE should draw from social science parts that deal with man, the way he behaves, organizes himself in groups, his relationships to his natural and physical environment, his control over his goal, to achieve EE goals and objectives. In other words the objectives of the social science curriculum should be re-evaluated and those specifically concerned with understanding, solving and preventing environmental problems should be incorporated in EE objectives as summarized in the chapter on EE methodology.

There are a lot of available materials within the secondary school social science curriculum on topics like land, people, customs, traditions, economic, political and social life, their histories, literature, religious art, education and many others. This material should be adapted for teaching of EE and stress laid on the total environment concept. Whatever procedures are chosen for exploiting the environmental dimension in the secondary school social science curriculum, materials have to be re-written to re-emphasise EE goals and to put in the problem solving approach. This can be done through teachers from different disciplines working together to produce interdisciplinary teaching/learning modules with clearly defined objectives, content, working guides for teachers and activities for students. Alternatively, team teaching could be utilized where the teaching of a topic, a discussion or a student project is based on one subject but teachers from other disciplines offer their views or give guidance when requested.

A major constraint in the development and introduction of EE in secondary schools in many countries is the question of funds. Hence, the justification for adoption and adaptation of material made for a different audience. Adopted materials should be re-adjusted to fit the cultural background, political direction, financial, human and other resources. Both adopted and locally prepared materials should make maximum use of local learning environments like the museums, game parks, factories, nature walks and others. Students could also take part in the preparation of teaching/learning materials for example by working on a project and collecting valuable information which is checked and incorporated in the module.

For the environmental dimension in question to be effectively taught, it becomes necessary to both train and re-train teachers and supervisors. This could be done through a pre-service course that is in itself integrated, interdisciplinary, problem oriented, and which train them in the methods of facilitating the inclusion of the environmental component in their teaching activities. In-service courses could be organized in stages to re-orient social science teachers on the objectives of EE, its content, preparation of materials, management (implementation) of that material in the classroom, and evaluation. Teachers could also learn from programmes arranged and communicated through mass media, seminars, workshops, exhibits and other national and international forums. These serve also to facilitate a wide distribution of materials and to avoid duplication. EE learning resource centres prove very useful to teachers.

Research and evaluation of the environmental component of the social science curriculum should be facilitated so as to provide a scientific and experimental basis for new innovations in EE. Research topics chosen by both teachers and students should be from the social science curriculum but be geared towards achieving EE goals and use EE methodology. The evaluation process should be done to ensure that:

1. The teaching/learning process is effective.

2. The materials locally prepared are effective.

3. Materials prepared abroad and locally adopted are relevant.

Relevance of all material should be based on a country's education needs and objectives, socio-economic needs and the specific environmental characteristics.

GLOSSARY

Airmass: A largely homogenous mass of air sometimes extending over hundreds of miles. It has characteristics of temperature and humidity bounded by fronts and originates in a specific source region.

Air pollution: The addition of substances in the air both qualitative and quantitative that alter its composition and make it harmful to life.

Atmospheric conditions: Particulars pertaining to the thin layer of colourless, odourless, tasteless gases surrounding the earth.

Catchment area: The area drained by a river.

Conservation of natural resources: Wise use of a natural resource so that it can be of maximum use to the largest number for as long as possible.

Continuous assessment: Is based on periodic assignments, quizzes, tests, practicals and project work to see if learning is taking place continuously as opposed to the use of terminal and final tests only. This ensures that students study and finish each assignment rather than wait to cram their work at the end of term for the purpose of passing the terminal examination.

Coral reef: A reef made of limestone, the accumulated skeletons of polyp colonies.

Cost benefit analysis: A kind of check-list where the costs of a project are offset against the benefits so as to determine whether the project is viable. The cost is not only in monetary terms but also in the effect of the project on the ecology of the area.

DDT: A chlorinated hydrocarbon is a chemical compound artificially produced to kill insects and pests. Was found to be very effective during and since World War II in reducing the incidence of malaria.

Deforestation: The removal of vegetation from an area. This leads to increased soil erosion, decreased rainfall and eventual desertification.

Desertified areas: Areas whose biological potential has been lost due to adverse human activities.

Environment and development: A concept that stipulates that development (social and economic progress) need not result in depletion of all types of resources. A country can choose a type of development that is sustainable by the local environment.

Environmental concept: That the environment is made up of physical, biological and socio-cultural components and these are interdependent. An imbalance in one will have repercussions in the others.

Environmental consequences: The result of activities, that are carried on within an area, on the ecological balance of the area and its ability to sustain life.

Development without destruction: A choice of economic and social progress that is in harmony with the environment. Other phases with the same meaning are, 'Development with ecological considerations'.

Environmental integrators: Individuals, such as teachers, who are able to pick out the environmental dimension in their subjects and make use of it or highlight it in their teaching with the aim of achieving environmental goals.

Environmental problems: Issues that are inherent with conditions found within an environment. Examples: rapid population increase in developing countries due to improved health facilities coupled with the traditional love of many children; presence of water borne diseases in tropical lands; obesity in industrialized countries due to overfeeding.

Environmental science: A type of EE given to environmental protectors such as engineers, health workers, administrators, architects etc. An EE course which is science based in a science college could be termed Environmental Science.

FAO: Food and Agricultural Organization (a UN body).

Fragile ecosystem: An area that due to its nature can easily be ecologically destabilized by the wrong choice of activities. Some of the most fragile ecosystems are semi-deserts.

Game cropping: Selected killing of wildlife for food and other economic benefits as well as to keep down the numbers. This has an advantage over poaching in that there is proper timing and consideration of the age and sex of the animals killed.

Game ranching: Keeping wildlife on a ranch or large grazing farm instead of or together with domestic animals. Game cropping keeps the wildlife in check.

Habitat: An area in which the requirements of a specific animal or plant are met.

Humus: The organic constitutent of soil which is formed from the decomposed remains of plants and animals due to the activities of bacteria and other organisms.

IEEP:

Igneous rocks: Rocks which have been formed by solidification of molten material or magma.

Integrated planning: A type of planning, adopted lately, that considers all aspects of an area from the earliest stages of project plans and implementation. Example: if a dam is to be built in a tropical area economic returns, ecological consequences must be known; the community must be involved (to ensure acceptance of the project) and educated about the consequences of the dam such as increased incidence of water borne diseases and on how to protect themselves. Hence many departments or ministries have to work together to ensure success of the project.

Interdisciplinary approach: ...That which draws its material or methodology from different disciplines.

International Drinking Water Supply and Sanitary Decade, Decade 1981-1990: A decade declared by UNO for the peoples of the world to make concerted efforts to provide everybody with clean drinking water and good sanitation by year 1990. Activities in each country are co-ordinated by UNDP representative and could be bilateral among countries e.g. a rich country gives money and technology to a poor one, or involves many organizations.

Intrusive rock: A category of igneous rocks that solidified deep in the earth's crust among the pre-existing rocks.

IUCN: International Union for Conservation of Nature and Natural Resources. It has its headquarters in Geneva.

Aquaculture: The rearing of fish and algae in ponds to supplement natural resources.

Marine resources: Things (or energy) that are derived from the sea e.g. fish, oil, shells.

Metamorphic rocks: Rocks that have chemically or physically changed their texture, composition or structure due to pressure and/or heat.

Natural resource: A thing or energy in the environment that is considered essential by human beings.

New International Economic Order: A move to create equity by various nations and international organizations in the world.

pH value: A quantitative degree of the acidity of water or soil measured on a scale of 14 a pH of 14 is alkaline while 7 is neutral.

Pollutant: Any substance in the wrong place e.g. litter or in the wrong quantity e.g. loud noise, or in the wrong quality, e.g. constituents of fumes emitted from a car engine. Pollutants could be man-made or natural e.g. pollen, dust.

Pollution: The addition of substances in the environment in quality or quantities that cause changes that are harmful to life. These substances are usually the waste products of human activities.

Population increase: Population change as indicated by birth rates, death rates and fertility of a population.

Problem oriented: Geared towards examination of issues, their causes, effects and possible solutions.

Problem solving approach: (See also problem oriented), an approach to teaching in which students are not only made aware of existing issues but also scrutinize their causes, effects, ways and means of eliminating them and preventing new ones. Students are encouraged to suggest or draw up a plan of action to solve the particular problem.

Example: In the study of soil erosion the following questions could be answered:

1. From where do we get the soil?
2. Is the soil threatened?
3. What are the causes of soil erosion?
4. Is there any solution to this problem?

By the end of the study on soil students should be able to answer the following or similar questions:

1. How have people interacted with land to change the environment around your home or village or your school?
2. What problems would develop along a watershed if eroded soil resulting from overgrazing by cattle or sheep or eroded soil resulting from an area burned in a forest fire filled the river?

3. What is the community doing in your area to prevent soil erosion?

4. What are the effects of good and bad land management in your district?

5. Can you describe the damage to forests resulting from fire, insects, tree diseases and unwise cutting practices, and what is being done to reduce this damage? (A forester could be invited to talk on this subject.)

6. Draw up a plan of action for combating soil erosion in your area.

Quality of Life: The type of life that a person leads. The quality of life is enhanced if the environment is protected and lowered if the environment is degraded. The quality of life is dependent on economic factors, ecological factors as well as social, cultural and political factors.

Range of temperature: The difference between the maximum and minimum temperature recorded in a day (24 hours).

Recycle: Reuse. Recycling is a means of reducing pollution by reusing waste material. Example: use of waste paper in the making of tissue paper; scrap metal in making steel; waste water for fish pond or irrigation.

Resource person: A knowlegeable individual from a relevant field that EE teachers use to impart knowledge to their pupils. Example: an old man to relate historical incidents, a health officer to speak on personal hygiene, an architect to speak on aesthetic beauty.

Sahel: The area immediately south of the Sahara. It forms a very fragile ecosystem.

Sahelian drought: The great Sahelian drought hit the Sahel region between 1968 and 1974 causing disruption, migrations and deaths of many nomadic people and their animals.

Sustained lifestyles: The choice of a way of living that can be supported by the environment.

Sustainable development: As above.

TVA: Tennessee Valley Authority.

UNDP: United Nations Development Programme.

UNEP: United Nations Environment Programme. This is the UN body initiated at Stockholm in 1972 and charged with matters concerning the environment. It has its headquarters in Nairobi, Kenya. Address: P.O. Box 30552, Nairobi, Kenya. Telephone No. Nairobi 333930.

World Conservation Strategy: A plan of action for living resource conservation for sustainable development drawn up by IUCN, UNEP, FAO, and Unesco. It is a pack containing:

1. Preamble and Guide
2. Executive Summary
3. World Conservation Strategy
4. Map Section.

The WSC has 3 objectives:

1. Maintenance of essential ecological processes and life support systems.
2. Preservation of genetic diversity.
3. Sustainable utilization of species and ecosystems.

WED: World Environment Day (5th June). A day set aside by the UN for Member States to consider more deeply the state of their environment.

The theme in each year varies according to the needs of each country but should be within the main theme of 'Development without Destruction'. Where possible activities like essay and poster competitions conveying the theme take place. On the actual day there is a parade followed by an address by a UN official.

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